

NYASALAND



PROTECTORATE

**Annual Report
of the
Department of Agriculture
For the years 1952 and 1953**

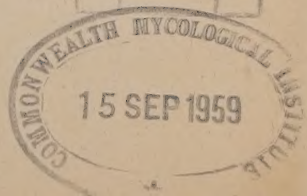
PART II

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INTRODUCTION

The 1952 Part II Report of the Department could not be printed in 1952, and therefore the material which would have gone into that Report has now been incorporated into the present combined 1952-53 Report which covers results and activities up to July, 1953. The presentation of the results of experiments is in accordance with the lay-out adopted in 1951 in that results are grouped under crops rather than under experiment stations.

No report is available from the Plant Pathologist, since the post became vacant in 1952.

The experiment stations in operation during the period under review and the officers who have been in residence are listed below:—

Agricultural Research Station, Lilongwe

Chief Agricultural Research Officer ..	..	..	..	S. T. HOYLE
Agricultural Officer (from January, 1953) ..	..	..	..	J. F. CONROY
Agricultural Officer	..	..	..	G. HEYS
Ecologist	..	..	..	G. JACKSON
Field Officer	..	..	..	R. E. JACKSON

Tea Experiment Station

Tea Research Officer	..	..	..	D. L. DOWNIE
Agricultural Officer	..	..	..	D. H. LAYCOCK
Agricultural Officer (part 1952)	..	..	..	G. HEYS
Field Officer	..	..	..	R. B. ROYLE

Tung Experiment Station

Agricultural Officer	..	..	..	J. A. SANDYS
Agricultural Officer (from June, 1953) ..	..	..	..	L. J. FOSTER
Chemist (until June, 1953)	..	..	..	C. V. CUTTING
Field Officer	..	..	..	A. B. HOUSTON

Tuchila Experiment Station

Officer in Charge	..	..	..	G. S. BARKER
Field Officer (from March, 1952)	..	..	..	J. W. KILLICK

Makanga Experiment Station

Officer in Charge (until August, 1952) ..	..	..	..	G. A. BUTLER
Officer in Charge (from August, 1952) ..	..	..	..	P. E. CARRALL-WILCOCKS

Mwera Hill Experiment Station

Agricultural Officer (until June, 1953) ..	..	..	..	L. J. FOSTER
Agricultural Officer (from June, 1953) ..	..	..	..	J. EVANS

Lisasadzi Experiment Station

Officer in Charge	..	..	..	R. F. CUMPTON
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Mbawa Experiment Station

Officer in Charge	..	..	..	F. HIGSON
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Provincial Agricultural Officers

Southern Province	..	..	..	M. F. H. SELBY
Central Province	..	..	..	H. W. T. WEBB
Central Province (June, 1952–December, 1952) ..	..	..	..	A. B. CORMACK
Northern Province (from August, 1952) ..	..	..	..	R. SMITH
Northern Province (until November, 1951) ..	..	..	..	G. F. GODDEN
Northern Province (November, 1951–August, 1952) ..	..	..	..	A. B. CORMACK

Headquarters

Plant Pathologist (until October, 1952) ..	..	..	..	P. O. WIEHE
Entomologist (from November, 1952) ..	..	..	..	E. L. DRAKE
Agricultural Chemist (until June, 1953) ..	..	..	..	V. R. GREENSTREET
Agricultural Chemist (from June, 1953) ..	..	..	..	C. V. CUTTING
Entomologist (Research)	..	..	..	DR. K. F. SALMOND

Water Development Branch, Blantyre

Water Development Engineer	..	..	..	G. A. N. STARMANS
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MAIZE

VARIETY

Replicated trials were conducted at seven centres in 1952 and six in 1953 and the order of yield of varieties was reasonably consistent throughout the whole series. The Southern Rhodesian hybrids have given the best yields which have ranged from eight to thirty bags an acre, depending on the season and type of soil. Owing to the soft grain and loose sheathing of the cobs these hybrids are subject to severe weevil infection, and unless they are efficiently fumigated shortly after harvest there is considerable loss during storage. They are not therefore recommended unless they can be used quickly as soon as harvested. Once grown hybrid maize was planted in the 1953 series of trials and this yielded from 40 to 75 per cent. of the double hybrid from which it came.

The selections of local maize made at Namalenga and Makanga have yielded on an average about three bags per acre less than the hybrid varieties but have the advantage that they keep well in store. These are flint or semi-flint types and are preferred by Africans for pounding into flour.

A large number of imported open-pollinated varieties have been tried and all very early types such as Wisconsin White Dent have given very poor yields. The best has been Potchefstroom Pearl which has generally yielded as well as the local selections and at some stations has exceeded them in yield. Of the yellow varieties Sahara has done well, yielding about one bag an acre less than local selections.

FERTILIZER TRIALS

In 1952 there were five and in 1953, four factorial experiments in which nitrogen, phosphate and potash were applied at three levels and the time of application of nitrogen was also varied. In addition there were three experiments solely concerned with the time of application of nitrogen.

NITROGEN

In eight out of the nine factorial experiments there was a significant increase in yield for the single application rate which was 20 lbs. N in 1952 and 15 lbs. N in 1953. The amount of increase varied from 430 to 1,080 lbs. per acre. The increase for the double application was only occasionally significant over the single rate.

TIME OF APPLICATION OF NITROGEN

In the factorial experiments there were two experiments in which splitting the application by applying half at planting and half three to six weeks later gave a significant increase over all at planting. When half the nitrogen was applied at the time of the first tassel emergence there was a consistent reduction in yield though in no case did the fall in yield quite reach the level of significance. The results of the three, time of application, experiments is given in the table below.

TABLE I: TIME OF NITROGEN APPLICATION ON MAIZE

Application of 100 lbs. sulphate of ammonia		Yield per acre in lbs.			
Number of applications	No. of weeks after planting	Chitedze	Mbawa	Lisasadzi	Mean
1	0	5,751	1,716	2,362	3,276
1	4	6,031	2,857	2,838	3,909
1	8	4,549	1,946	1,695	2,730
2	0 and 2	6,098	2,933	2,557	3,863
2	0 and 4	6,200	2,390	2,903	3,831
2	0 and 6	5,369	2,387	2,695	3,484
2	0 and 8	5,331	2,273	2,538	3,381
2	0 and 10	5,850	2,123	2,820	3,598
L.S.D.		Not sig.	398	432	

These results show a consistent advantage for an early application and the highest yields have come from applying half at the time of planting and half two to four weeks later.

POTASH

On no occasion was any significant increase recorded. In 1953 the maximum rate of application was 150 lbs. K₂O and no effect could be detected.

PHOSPHATE

There was only one experiment of the series (Chitala, 1952) which showed any significant increase for phosphate. On this occasion 40 lbs. of P₂O₅ (applied as super and raw rock) gave an increase of 348 lbs. per acre. The fertilizer was applied from measuring cups in concentrations about 4 ins. from the plants and it is possible that this is not the most effective way of placing it.

RESIDUAL FERTILIZERS

In 1953 there were two residual experiments and at Tuchila no responses were found. At Chitedze there was a significant response from both 200 and 400 lbs. of super and raw rock mixture applied the previous year. There had been no response in the year of application.

MINOR ELEMENTS

In a small observation block at Mbawa in 1953 no effects could be seen from the application of boron, manganese, copper, cobalt, molybdenum or zinc. In a microplot experiment at Mbawa in 1952 in which the plants were weighed green when six weeks old there were marked increases in weight due to nitrogen and phosphate but calcium caused a big drop in weight.

CULTURAL TREATMENTS

Spacing: There were four experiments in 1952 and three in 1953. The spacing included rows 3 ft. and 6 ft. 6 ins. apart and plant populations ranging from 9,700 to 19,400 plants per acre. The results showed that the wide spacing of rows, to allow of tractor cultivation throughout the season, caused a reduction of about 10 per cent. in yield. Apart from the effect of the wide rows it is necessary to have about 14,500 plants per acre (rather more in a wet year) but the arrangement does not matter provided there is a full stand. For hand planting 3 ft. $\times$ 3 ft. with three plants per hill is recommended and for machine planting 3 ft. $\times$ 1 ft. with single plants will give the best yield.

Time of planting: At Chitedze an experiment was planted with three varieties (local, S.R. Hybrid, and Sahara) three rates of application of N (nil, 10 and 20) and three times of planting (10th November, 1st and 22nd December). The last time of planting had to be abandoned owing to the impossibility of getting a good stand as all the birds of the district concentrated on these few late plots. The varieties and nitrogen application gave much the same results as the other trials including these factors, except that local maize did not respond to nitrogen as much as the imported varieties. The following table gives the effect of time of planting and application of nitrogen.

TABLE II: TIME OF PLANTING AND RATE OF NITROGEN EFFECTS

(Yield in lbs. of Grain per Acre)			
Rate of N	Time of Planting		Mean
	10th Nov.	1st Dec.	
nil	4,187	3,484	3,835
10 lbs.	4,464	3,911	4,182
20 lbs.	5,674	4,269	4,972
Mean	4,775	3,888	
L.S.D.	530 lbs. per acre		

It is evident that the early planting had a very marked effect on the yield, and the December planting with 20 lbs. of nitrogen per acre is little better than the November planting without fertilizer. In addition the highest rate of fertilizer has increased the yield by 1,500 lbs. per acre for the November planting but only 800 lbs. for the December planting.

CHEMICAL WEED CONTROL

Two experiments were carried out at Chitedze and Rivi Rivi, using Fernoxone and Fernamine which are the sodium salt and amine of 2-4-D. The main weeds of maize are grasses, and the chemicals were applied two and four days after planting as a pre-emergence spray. At Chitedze the control of grasses was slight but a very marked effect was found at Rivi Rivi, the Fernoxone being better than the Fernamine. It was also found, however, that the Fernoxone reduced the stand of maize and, probably for this reason, there was little increase in yield of maize.

BREEDING WORK

Some 900 lines were self-fertilized and are now in the fourth and fifth years of inbreeding. These are all from local stocks taken from various parts of the country. A topcross yield trial was carried out using 64 inbreds for the female, and Namalenga and a Southern Rhodesian single cross as male parents. The growth of this trial, although rather late planted, was very satisfactory and yields were high. More topcrosses using Namalenga as the male parent were made in an isolation block. Inbreds from Southern Rhodesia, South Africa and Georgia were propagated by selfing or sibbing.

DISEASES

Puccinia polysora has been recorded for the first time in the country. Specimens of diseased leaves were sent to the Commonwealth Mycological Institute for identification and in one specimen teleutospores were discovered. The disease was recorded from most districts in the Southern and Central Provinces but it was not found in the Northern Province.

In no case was severe infection noticed till the tasselling stage had been reached. This may have been due to late appearance of the disease in the country, but at Chitedze a late planted field of maize alongside an early field which was severely attacked, did not develop much disease till the tasselling stage was reached. It is therefore possible that the climate in Nyasaland is such that the disease will not attack the young maize plant to any extent.

No clear indication of loss of crop was recorded but some fields of Southern Rhodesian hybrid seed which were severely attacked had smaller cobs than usual and the grain appeared to be somewhat shrivelled. The bushel weight of the grain from these fields was noticeably low.

Several observers noticed that local strains appeared to be attacked less than Southern Rhodesia hybrid and the following figures from Chitedze relate to the percentage of leaves attacked, but without reference to the severity of the attack.

TABLE III: MAIZE RUSTS

Maize variety	Percentage of leaves infected with:—		Bushel weight lbs.
	<i>P. sorghi</i>	<i>P. polysora</i>	
N3.-A. 5 × M9. T4	67	63	55.7
N3. A5 × K4. N2	82	54	55.0
N3. A5 × K4. M9	68	25	60.8
Potchefstroom Pearl	84	27	59.2
Sahara	55	34	62.9
Namalenga	84	7	60.6
Station local	72	9	64.6
Makanga	73	11	59.5

It is impossible to draw firm conclusions from one set of observations but the above figures are suggestive, and it is possible that bushel weight may be a useful criterion. The hybrid with the least *P. polysora* infection has a greater bushel weight than either of the other two hybrids. The percentage infection of the local strains is much lower than that of the imported varieties and it is possible that there is some useful degree of tolerance to the disease in the local strains.

SORGHUM

Work on this crop, which is not grown extensively, has been confined to observational work on some 60 varieties at several stations. The highest yields, on unreplicated plots, have been given by the following varieties:—

TABLE IV: PROMISING SORGHUM VARIETIES 1952-53

Station	Tuchila	Makanga and Misanje	Chitedze	Mbawa	Chitala
Sorghum Varieties	S/S 28	S/S 10	U/S 12	N/S 2	S/S 25
	S/S 25		Dobbs	U/S 12	S/S 28
	U/S 9		T/S 16	N/S 5	S/S 46
	T/S 26		P. 127	U/S 5	U/S 2
	T/S 23		T/S 1	U/S 6	U/S 16
			U/S 17	T/S 8	S/S 10
			J. 7	47/C	S/S 40
			A. 7	NYIFE	T/S 19
					T/S 23

ELEUSINE

Observation plots were planted at Mbawa in 1952. A number of local varieties were planted with three tons per acre of farmyard manure and four varieties yielded over 600 lbs. per acre. These were *Dzanja la nyani*, *Kapfunya*, *Chidzungumwele*, and *Zala za Mkango*. Four varieties from Uganda were planted with ten tons, two tons and no farmyard manure, and the average yields per acre were 575, 425 and 243 lbs.

In 1953 further observation plots were planted using 2½ tons of farmyard manure per acre and the four leading varieties were *Nathenje "B"*, *Chola cha nkhwewe*, *Phagalala Didi*, and *Emoru* (Uganda) which yielded at the rate of 1,000 to 1,500 lbs. per acre.

In an unreplicated fertilizer trial, muriate of potash gave a large increase in yield which was a little more than that from sulphate of ammonia. There was no response to phosphate.

CEREALS

WHEAT

Nyika: Tests of Kenya varieties of winter wheat gave poor growth and most of the varieties yielded at less than 500 lbs. grain per acre. The best results were:—

					Lbs. per acre
261. R7. C. 1B	..	..	..	..	1,470
291. J. 1. II	..	..	..	..	990
350. AD. 902	..	..	..	..	850
Sabanero	..	..	..	..	740

Vipya (Champoyo): A factorial fertilizer experiment had an average yield of 725 lbs. per acre and the only significant effects are given below:—

Fertilizer	Effect in lbs. per acre
100 lbs. super-phosphate	189
25 lbs. potash	126
25 lbs. potash × 3,000 lbs. lime	202
3,000 lbs. lime × 25 lbs. magnesium	151
L.S.D.	154

There were no significant effects from a residual trial and previous results are confirmed that phosphate is more important than nitrogen in this area.

Vipya (Luwawa): Growth was poor and the crop averaged only 280 lbs. per acre.

Neno: An observation on time of planting, which suffered a good deal of damage from birds, showed that March planting gave better yields than April. Sample measurements on various African gardens showed that the yield per acre was in the region of 900 lbs.

Sombani (irrigated): A factorial fertilizer experiment with an average yield of 800 lbs. grain per acre showed that 100 lbs. of sulphate of ammonia increased the yield by 240 lbs. per acre and that 200 lbs. of super-phosphate and raw rock mixture and 25 lbs. of muriate of potash had no effect. There was a significant interaction between nitrogen and phosphate of 110 lbs. per acre.

Bvumbwe: Two fertilizer trials were carried out using Sabanero, the first one being sown on 17th March and gave an average yield of 182 lbs. per acre and no significant effects. The second trial was planted on 3rd April and the average yield was 457 lbs. per acre and gave the following results:—

TABLE V: WHEAT FERTILIZER TRIAL—BVUMBWE 1952-1953

(Yield in lbs. of grain per acre)

Rate of N	Yield	Rate of P ₂ O ₅	Yield	Time of Application
0	389	0	397	All before planting .. 409
20 lbs.	467	20 lbs.	451	$\frac{1}{2}$ before planting } .. 500
40 lbs.	514	40 lbs.	522	$\frac{1}{2}$ 3 weeks later } .. 462
				$\frac{1}{2}$ before planting } .. 462
				$\frac{1}{2}$ 6 weeks later }
L.S.D.			47 lbs.	

Five varieties from Kenya were planted in January and the highest yield obtained was 112 lbs. per acre. It was evident that the rainfall was too heavy for good growth and these varieties will not grow as a summer crop in this area. Variety 360 H was the only one which was free from rust disease.

Chitedze: Three summer wheats from Kenya were planted on 15th January and germinated well but were entirely eaten by pigeons when 4 to 5 ins tall. A second sowing on 3rd February did not suffer from bird damage but died out through lack of moisture.

Mwera Hill: Five varieties of Kenya summer wheats were planted in observation plots at three dates of sowing. Bird damage and rust attack was slight and the following yields per acre obtained:

TABLE VI: WHEAT VARIETY TRIAL—MWERA HILL, 1953

(Yields in lbs. of grain per acre)

Variety	Date of Sowing		
	7-1-53	31-1-53	28-2-53
184	1,417	1,333	667
294	1,400	1,300	300
318	1,083	417	nil
337	583	667	nil
360	1,800	500	nil

OATS

Nyika: Observation plots of huskless oats were grown and the following yields obtained:—

No fertilizer	662 lbs. per acre
100 lbs. per acre sulphate ammonia	1,036 lbs. per acre
100 lbs. per acre superphosphate	1,011 lbs. per acre
Supers (100 lbs.) and sulphate of ammonia (100 lbs.) ..	1,067 lbs. per acre.

Vipya (Champoyo): A fertilizer experiment gave the good average yield of 1,491 lbs. per acre and nitrogen had a significant effect of 246 lbs. per acre and phosphate 221 lbs.

A residual fertilizer trial was planted and in spite of a fairly severe attack of rust the yield averaged 1,055 lbs. per acre. The only two significant residual effects were 233 lbs. per acre for phosphate and a negative one of 258 lbs. for potash.

BARLEY

Nyika: Observation plots grew very badly and the best yield was 360 lbs. per acre.

Vipya (Champoyo): In a fertilizer trial the average yield was 1,267 lbs. per acre but none of the fertilizers (N,P,K,Ca,Mg) showed any response. In a residual trial, from a similar experiment the previous year, the average yield was 833 lbs. and phosphate gave a significant increase of 265 lbs. per acre.

RYE

Nyika: Observation plots were grown at Lusero and the following yields recorded:—

No fertilizer	554 lbs. per acre
100 lbs. per acre sulphate of ammonia	761 lbs. per acre
100 lbs. per acre superphosphate	901 lbs. per acre
Supers (100 lbs.) and sulphate of ammonia (100 lbs.)	904 lbs. per acre

Vipya (Champoyo): A fertilizer trial (N,P,K,Ca,Mg) with a yield of 1,097 lbs. per acre showed that phosphate gave the only response of 265 lbs. per acre. In a residual trial, from a similar experiment from the previous year, significant responses were found for phosphate, 290 lbs., and lime 340 lbs. per acre.

RICE

Variety trials—Karonga: Simple trials were carried out in 1952 and 1953 with the following results:—

	1952	1953
	(lbs. paddy per acre)	
Demarara	2,836	—
Faya	2,779	3,040
Burma	2,399	—
Majimaji	2,261	—
Kahogo	—	3,484
L.S.D.	325	—

Fertilizer trials—Karonga: An experiment was planted in 1952 in which the no fertilizer plot yielded at the rate of 2,670 lbs. per acre and 200 lbs. of sulphate of ammonia per acre gave a significant increase of 350 lbs., whereas 100 lbs. of super-phosphate gave no increase.

Sombani: A fertilizer trial (NPK) was carried out in 1953 and none of the fertilizer gave significant increases.

CASSAVA

Work has been confined to making a collection of local varieties and to distributing a number of strains of mosaic resistant varieties from E.A.A.F.R.O. The disease resistance of the latter has been well maintained but their yield potential has not yet been proved.

IRISH POTATOES

Vipya: Observation plots were planted and the best yield of 6½ tons per acre was given by a red-skinned variety planted in November with farmyard manure. The white-skinned type yielded about a ton less per acre and without manure the yield was halved. Plantings made in January yielded at the rate of three to four tons per acre.

Bvumbwe: Two fertilizer trials (NPK) were planted one with an overall dressing of 20 tons per acre farmyard manure and one without manure. In the experiment with farmyard manure the growth was slow and the general average was 2 tons per acre less than without farmyard manure. There were no significant differences due to the minerals in the presence of farmyard manure. The results in the absence of farmyard manure were as follows:—

TABLE VII: IRISH POTATO FERTILIZER TRIAL—BVUMBWE, 1952
(Yield in tons per acre)

Rate of N	Yield	Rate of P ₂ O ₅	Yield	Rate of K ₂ O	Yield
nil	12.48	nil	12.69	nil	13.77
30 lbs.	13.58	90 lbs.	13.31	90 lbs.	13.19
60 lbs.	13.64	180 lbs.	13.70	180 lbs.	12.74
L.S.D.		1.09 tons			

DARK-FIRED TOBACCO

VARIETY

Work in line breeding continues and some selections are showing promise but have not yet reached the distribution stage. The selected bulk seed used on African trust land gives a very satisfactory type of leaf if grown under proper conditions, and it is consequently more difficult to find superior strains. Nothing outstanding has been found among the new varieties imported from America and in general they do not suit Nyasaland conditions as well as our own strain. It is interesting to record that some seed from Nyasaland was sent to Kentucky and it is reported that it has grown as well as any of their own strains.

FERTILIZERS

Replicated trials were grown at Chitedze, Lilongwe and Tuchila in 1952 and 1953 and showed the outstanding importance of nitrogen. The yields and value per acre (using the price paid to the grower by the African Tobacco Board) are shown in the following table:—

TABLE VIII: TOBACCO FERTILIZER TRIALS—1951-52 AND 1952-53

(Yields in lbs. of cured leaf per acre)

	Mean No nitrogen		Increase for 20 lbs. N		Further increase for 40 lbs. N		Lowest sig. diff.	
	Lilongwe	Tuchila	Lilongwe	Tuchila	Lilongwe	Tuchila	Lilongwe	Tuchila
Yield (1951-52) ..	414	233	267	177	221	98	61	31
Value ..	£6- 5s	£4-16s	£6-12s	£6-10s	£11	£5-17s	£2-10s	£1-9s
Average per lb. ..	3.6d	4.9d	4.5d	6.6d	6.3d	8.1d	—	—
Yield (1952-53) ..	721	463	235	117	111	nil	62	60
Value ..	£29-14s	£11-5s	£18-4s	£6-7s	£9-17s	nil	£4-9s	£3-1s
Average per lb. ..	9.9d	5.8d	12.0d	7.3d	13.0d	7.4d	—	—

The time of application of nitrogen has given very varied results and this may be expected to differ with the season. In the "wet" year 1952 there was an advantage in applying half the amount of nitrogen six weeks after planting but not in the drier 1953 season.

No increase in yield or value has been recorded for either phosphate or potash. Both these fertilizers were applied before planting in concentrations 4 to 6 ins. from the plant. In 1953 potash (K_2O) was applied at the rate of 160 lbs. per acre and the increase in value just failed to be significant, while the actual increase in value did not equal the cost of the fertilizer. The fields on which these experiments were carried out were all recently opened from bush. On fields where cropping had been heavy for some years and a high nitrogen application was made, symptoms of potash deficiency were observed.

CULTIVATION

An experiment comparing spacing, number of leaves, and varying rates of nitrogen application has been carried out for two years at Chitedze with the result given in Table IX.

TABLE IX: CULTURAL AND FERTILIZER TRIAL ON DARK-FIRED TOBACCO—CHITEDZE

(Yields in lbs. of cured leaf per acre)

		Yield per acre		Value per acre			Value per lb.	
		1952	1953	1952	1953		1952	1953
<i>Intra row spacing</i>				£ s d	£ s d			
2 ft.		823	1,292	14 15 0	56 11 0	4.3d	12.0d	
3 ft.		683	924	13 4 0	45 18 0	4.7d	13.6d	
4 ft.		568	776	12 10 0	40 2 0	5.3d	14.2d	
<i>No. of leaves</i>								
1952	1953							
7.8	6.6	606	875	13 10 0	35 13 0	5.4d	13.8d	
8.6	7.7	701	988	13 9 0	48 17 0	4.6d	13.2d	
9.6	9.4	768	1,148	13 10 0	58 1 0	4.2d	12.4d	
<i>Nitrogen</i>								
1952	1953							
nil	20 lbs.	440	841	6 9 0	43 19 0	3.5d	11.6d	
20 lbs.	40 lbs.	757	1,025	13 13 0	47 12 0	4.3d	13.0d	
40 lbs.	60 lbs.	878	1,126	20 8 0	51 0 0	5.6d	14.1d	
<i>Sig. diff.</i> (P=0.05)		78	84	4 6 3	4 16 0	—	—	

NOTE.—All rows were 3 ft. apart and the value given is the African Tobacco Board prices to the grower.

The two seasons were very different for the production of tobacco, as can be seen from the greatly increased value per lb. and yield in 1953. In 1952 the closer spacing gave a greater yield but the value per acre was not significantly greater. In 1953 both the yield and value were significantly greater at the closer spacing.

In 1952 the larger number of leaves gave a greater yield but the lowered value per lb. was enough to offset this increase. In 1953, however, the increased yield from the greater number of leaves more than made up for the decreased value per lb.

The effect of nitrogen was very marked and in both years it not only increased the yield per acre but also the value per lb. of the leaf. There was no interaction between the fertilizer treatment and the spacing or number of leaves left on the plant.

FLUE-CURED TOBACCO

VARIETY

A trial was carried out at Lisasadzi in 1952 and 1953 with nine varieties and the results are given in the table below:—

TABLE X: VARIETY TRIAL—FLUE-CURED TOBACCO, LISASADZI

Variety	1952		1953	
	lbs. per acre	lbs./acre	Grade index	Crop index
Delcrest	789	1,040	23.3	23,640
Yellow Mammoth ..	738	935	25.0	23,376
Willow Leaf	712	961	22.7	20,091
Gold Dollar	710	992	24.4	24,660
Bonanza X Jamaica Wrapper	667	810	25.4	20,513
Jamaica Wrapper ..	663	1,072	21.9	24,989
Duquesne	636	926	25.3	23,622
Bonanza	623	1,058	26.7	28,412
White Stem Orinoco ..	598	1,026	20.4	20,988
L.S.D.	130	217	3.2	6,799

The grade index is an estimate of the average value of the leaf based on a system of points for each grade and the crop index is found by multiplying the weight of each grade by its index number. These results do not show a great variation between varieties. Delcrest and Yellow Mammoth have done well in both years. Bonanza was one of the lowest yielders in 1952 but was the second best in 1953 and, combined with a high grade index, had the highest crop index of all.

FERTILIZER TRIAL

The problem of the correct fertilizer practice for flue-cured tobacco on the sandy soils in the Kasungu District continues to be one of considerable difficulty. The results from the 1953 factorial experiment are given in Table XI.

TABLE XI: FERTILIZER TRIAL—FLUE-CURED TOBACCO LISASADZI

Fertilizer		lbs. per acre	Grade index	Crop index
N	10 lbs. ..	902	24.9	22,504
	30 lbs. ..	1,168	24.3	28,440
	50 lbs. ..	1,256	21.0	26,212
P ₂ O ₅	nil ..	1,082	23.4	25,084
	21 lbs. ..	1,120	23.5	26,230
	42 lbs. ..	1,124	23.2	25,844
K ₂ O	nil ..	1,054	22.7	23,716
	75 lbs. ..	1,108	23.6	26,058
	150 lbs. ..	1,164	23.8	27,386
L.S.D. ..		134	1.8	3,296

The effect of nitrogen is about what might be expected with the yield steadily increasing but the value decreasing with the highest application. There is no effect for phosphate and this might be due to the smallness of the application, or the fact that it was applied in a small concentration and not in a band. Potash applied at a high rate has given a significant increase in the Crop index and this is the first time that such a result has been shown. The effect of the potash was evident in the field where the plots with high potash had a markedly smoother type of leaf than those which lacked potash.

DISEASE

There was a very severe attack of *Alternaria longipes* in 1953 and it was difficult to find a connection between the severity of the attack and any cultivation or fertilizer practice. A survey of the estates was carried out and the attack seemed to be as severe on those which had carried out a careful programme of field sanitation as those which had left primings in the field or ploughed in the previous crop. It did appear that the later planted fields were generally freer of the disease and this may have been due to the weather conditions during the later period of growth, or to the fact that some of the nitrogen accumulated in the soil may have been leached out and there was a higher ratio of phosphate and potash to nitrogen available to the plant.

There was no evidence from the experiments that phosphate reduced the amount of disease when up to 78 lbs. of P₂ O₅ per acre was applied. The high potash plots did have a higher leaf value but this may have been due to better texture rather than absence of disease.

OIL SEEDS

GROUNDNUTS

Varieties:

Five varietal trials were planted in order to assess the value of the many varieties, about 120, in the collection at Chitedze. The results were contradictory in that at two stations the late runner types gave the best yield and in three the early bunch types were highest. The trials will therefore be repeated.

Fertilizers:

Two experiments in 1952 and five experiments in 1953 were carried out using nitrogen and phosphate and in six of these no significant responses were found, though the application of phosphate caused a marked visual increase in the amount of foliage. The results of the experiment at Toleza, which did not include nitrogen, are given in the table below:—

TABLE XII: GROUNDNUT FERTILIZER TRIAL—TOLEZA, 1953

Super and Raw Phosphate		Lbs. of shelled nuts per acre
nil		1,064
100 lbs.		1,407
200 lbs.		1,452
L.S.D.		296

Minor elements: A small observation of the effect of boron, manganese, copper, cobalt, molybdenum and zinc was tried at Mbawa, and no effect was noted.

Time of planting: A trial was carried out at Chitedze and the bunch types gave the best yield with the earliest planting but the runner type did best when planting was delayed till mid-December.

Cultural treatments:

Spacing: In 1952 the last of a series of spacing experiments was carried out with Gambia bunch using spacings which varied from 35 to 104 thousand planting holes per acre. In general these experiments have shown that the more plants per acre the greater the yield, but there is a limit above which it is not practical to go. If the rows are kept to 3 ft. apart and two lines are planted on each ridge a spacing of 6 ins. gives 58 thousand holes per acre and 9 ins. between holes gives 39 thousand holes per acre. Somewhere between these two limits should be aimed at and two seeds should be planted in each hole.

Disease

An experiment was laid out at Chitedze to determine if seed dressing with Agrosan or spraying with Perenox to control *Cercospora* *sp* had any effect on the yield. The Perenox was sprayed three times at fortnightly intervals beginning with the fourth week after planting. The variety used was Gambia bunch and the results are given in the table below:—

TABLE XIII: TREATMENT OF CERCOSPORA ON GROUNDNUTS

(Yield in lbs. of shelled nuts per acre)

Seed Dressing:				nil	Agrosan	Mean
Perenox	nil			657	722	689
	sprayed	..	..	1,494	1,397	1,445
Mean				1,076	1,059	1,067
L.S.D.				288		

No advantage came from seed dressing with Agrosan and the germination from the untreated plots was not different from the treated plots. There was some visual effect on the sprayed plots and the leaves stayed green longer than on the unsprayed plots but the effect of the spraying was unexpectedly large. It seems possible that it might be partially due to a copper deficiency in the soil.

CASTOR SEED

Observation plots of a number of short and long term varieties were planted at Chitedze. Yields from these were very low and the flowering spikes appeared to be attacked by a disease which caused nearly all the flowers to die without fruit formation.

LINSEED

Vipya: Three varieties were planted in February and yields ranged from 245 to 385 lbs. per acre.

Chitedze: Four varieties were planted at dates varying from early January to late February. The best yield was 550 lbs. per acre from the earliest planting and yields got steadily less with later plantings. The planting of 28th February only yielded 65 lbs. per acre. It was noticeable that the quicker maturing strains gave the highest yields.

SUNFLOWERS

A number of varieties were grown in small plots at Chitedze and Tuchila and some good yields were obtained. The highest yielding varieties are given below:—

Variety	Chitedze			Tuchila	
			lbs. per acre		
Kampala	2,057	..	1,859		
Giant Black	1,365	..	2,067		
Kampala White	1,755	..	1,781		
Giant White	1,331	..	1,863		
Black Mars	1,512	..	1,641		
Katete	1,815	..	1,467		
White Russian	1,075	..	1,825		

SOYA BEANS

A time of planting and variety trial at Chitedze showed that the highest yield came from the first planting in mid-December and fell off on later plantings. The highest yields recorded from the first time of planting were Pelican 870 lbs., CNS 791 lbs. and Ogden 703 lbs. per acre. Some 45 other varieties collected from various parts of the world were grown under observation the yields of most of them being less than the varieties quoted above.

Some varieties were grown at Bvumbwe and Hernon 237, Benares and MIS. 28EB. 3109 yielded twice as much as the local yellow and black varieties.

SESAME

At Chitedze 16 varieties were planted in small plots and seven of them yielded at the high rate of over 1,000 lbs. per acre. At Makanga one variety gave 900 lbs. per acre and the other about 500 lbs.

SAFFLOWER

Trial plots have been planted at Chitedze and a large range of places in the Southern Province. Yields have been generally low, ranging from 200 to 300 lbs. per acre with one plot giving over 600 lbs. The crop is troublesome to harvest and thresh without mechanical equipment and shows little promise for this country.

ANNUAL REPORT OF THE TEA EXPERIMENTAL STATIONS

Unless otherwise stated the report covers the crop year July 1st, 1951, to June 30th, 1952, and July 1st, 1952, to June 30th, 1953.

NURSERY EXPERIMENTS

(i) *Manurial Experiment, Swazi*

An experiment was laid down in 1951 comparing the following treatments applied to nursery seedlings:—

- N₀, No sulphate of ammonia and N₁, 1 oz. of sulphate of ammonia per square yard of nursery bed.
- P₀, no superphosphate and P₁, 1 oz. of superphosphate per square yard.
- K₀, no muriate of potash and K₁, 1 oz. of muriate of potash per square yard.
- D₀, no dung and D₁, 5 lb. dung per square yard.
- B₀, seed germinated in pits and then transplanted to nursery beds and B₁, seed planted directly into beds.

Dung was applied about one month before the seeds were planted and the artificials about eight months after planting. Germination counts were taken at weekly intervals and showed that whereas dung had little effect on rate of emergence above ground, transplanted seed appeared at a quicker rate than untransplanted seed.

Girth measurements were made on all seedlings at 4 ins. above ground level when they were about 18 months old, and about one year after the fertilizer treatments were first applied. No significant differences in mean girths were obtained. The seedlings will remain in the nursery beds for another 12 months and have received a second annual application of dung and fertilizers. It is intended to transfer this experiment to the field at Mimosa during the next planting season (*i.e.*, December, 1953).

(ii) *Effect of a Fertilizer Mixture, Mimosa:*

In the factorial establishment of tea experiment described below, one treatment pair is the presence or absence of fertilizer in the nursery. An application of 1 oz. per sq. yd. of nursery bed of a mixture containing 6 per cent. N 10 per cent. P and 8 per cent. K was made, and immediately after planting out in the field, girth measurements were taken on the stumps to give an estimate of this treatment effect. Two field sites were chosen and as both were planted with stumps from the same nursery area it is to be expected that at each site girth measurements should be virtually the same. For both sets of stumps an application of nursery fertilizer caused a small but significant increase of mean girth (at $P = 0.05$).

NOTE.—In the above two nursery fertilizer experiments the Mimosa nursery was on a poor soil growing plants for the second consecutive time, whereas on the Swazi nursery the seedlings were growing on a good soil under tea nursery for the first time. These nursery soil differences most likely account for the differences in response to fertilizer obtained between the two experiments.

(iii) *Size and Density of Seed, Swazi:*

The full results of this experiment, published in the *Nyasaland Quarterly Agricultural Journal* (Vol. X. No. 4, 1951) show that big seed over $\frac{1}{2}$ an inch in diameter makes a significantly more efficient use of nursery area than does seed under $\frac{1}{2}$ an inch in diameter. Small seed require, on the average, 50 per cent. more nursery area than large seed to produce the same number of usefully sized seedlings.

(iv) *Pit versus Bed Planting of Seed, Swazi:*

The seedlings from the 1951 experiment, on various methods of seed treatment and seed sizes, were used to determine growth (as measured by stump diameter) after various treatments. The diameters of the stumps were measured 6 ins. above ground level when the seedlings were 18 months old and the results are given in Table XIV.

TABLE I: EFFECT OF SEED SIZE AND TREATMENT ON STUMP DIAMETERS IN CMS.

	Seed more than $\frac{1}{2}$ in. diam			Seed less than $\frac{1}{2}$ in. diam.			Mean		L.S.D. P.0.05
	Immediate Sinkers	2 hour Sinkers		Immediate Sinkers	2 hour Sinkers				
Seed from germinating pits	4.47	4.08	..	4.15	4.10	..	4.20	..	0.17 cms.
Seed direct to nursery bed ..	4.40	4.18	..	3.68	3.65	..	3.97	..	—
Mean	4.43	4.13	..	3.91	3.87	..	—	..	—
L.S.D.		P.0.05 = 0.35 cms.							

It will be seen that the seedlings from seed which was germinated in a pit before sowing in the nursery bed are significantly larger than those from seed sown directly into the bed and that large seed has produced bigger seedlings than those from small seed.

Although these differences are not large they confirm 1951 results, that it is better to use seed which is larger than $\frac{1}{2}$ an inch in diameter and, if possible, to reject those which do not sink after two hours immersion in water.

(v) *A correlation between stem diameter and root weight, Swazi:*

In estate practice it is usual to select seedlings for planting out in the field by their stem diameters at a chosen height above ground. 4 ins. being a usual height and pencil thickness or more being the usually selected diameters. New vegetative growth after planting must for a time be dependent upon starch reserves within the root, and a large root might be preferable to a small one. The connection between stump diameter and root weight was calculated by measuring the diameters at 4 ins. above ground of about 400, 18 month old seedlings and then cutting off their roots and weighing them. In the absence of facilities for chemical analysis it is assumed that total root weight would be a near measure of starch reserves. All roots were tested for starch with iodine solution and only seven were found to be without. The data is summarized in Table XV.

TABLE II. EFFECT OF STEM DIAMETER ON ROOT WEIGHT IN EIGHTEEN MONTH OLD SEEDLINGS

Diameter cms.	..	0.2	..	0.3	..	0.4	..	0.5	..	0.6	..	0.7
Mean root weight gms.	..	4.8	..	7.3	..	12.5	..	17.3	..	22.7	..	30.0
Number of Plants	..	5	..	14	..	37	..	62	..	86	..	61
Diameter cms.	..	0.8	..	0.9	..	1.0	..	1.1	..	1.2	..	1.3
Mean root weight gms.	..	38.7	..	45.5	..	50.1	..	62.1	..	76.5	..	76.0
Number of Plants	..	62	..	47	..	20	..	10	..	2	..	1

A correlation coefficient of + 0.98 was obtained between stem diameter and root weight and is significant at $P = 0.01$. The result of this observation shows that at 18 months of age, stem diameter is a good indication of the root weight. An increase of 0.01 cm. in diameter is accompanied by an increase of about 5.0 gms. in root weight which is fairly consistent throughout the range of diameters obtained.

(vi) *Shade and no Shade in the Nursery, Swazi:*

A small experiment was carried out to compare the effects on stem diameter of leaving nursery over head shade throughout the second dry season against the usual practice of removing it; and of topping seedlings at 2 ft. above ground level against the usual practice of leaving seedling growth untouched. Diameter measurements at 4 ins. above ground show that no significant differences were produced due to treatments, though small decreases were obtained by leaving the shade and by topping the plants.

(vii) *Cuttings, Swazi:*

No new cuttings were planted this season. Of those recorded in the 1951 Report an overall average of 15.6 per cent. survive. Great differences are shown between the surviving capacity of clones; the two best having 61.9 and 49.5 per cent. survivors and the two worst none.

ESTABLISHMENT OF TEA STUMPS IN THE FIELD

(i) *Shading of Tea Stumps, Mimosa:*

An experiment comparing nine methods of shading newly planted tea was laid down at Mimosa and compared no shade, small open ended pots, grass bottle shades, sunhemp, sword bean, pigeon pea untouched and pigeon pea lopped at 4 ft., *Tephrosia* untouched and *Tephrosia* lopped at 4 ft. A severe attack of *Helopeltis bergrothi* developed during May, 1953, and favoured sword bean as a host plant; this had therefore to be uprooted.

This prototype experiment fulfilled its original object and is being used to give observational information on the effect of low shade on the growth of young tea. There was no significant difference between treatments as far as survival of tea stumps was concerned, most likely due to excellent rainfall distribution and intensity for the first months after planting (1951-52). It became apparent that the cover crop shade was far too dense and resulted in an etiolation and weakening of tea growth. This shade was therefore thinned. Sunhemp failed at its second planting.

(ii) *Establishment of Young Tea Stumps in the Field, Mimosa and Tung Station:*

The first of an annual series of this experiment was planted at Mimosa and the Tung Station. The latter site in Cholo being chosen as a marginal (hence difficult) area for tea.

Five treatments, each at two levels, are compared and each field site contains two complete replications:—

- (a) 18 month old stumps against 30 month old stumps.
- (b) No nursery fertilizer against 1 oz. fertilizer (Compound A 6: 10: 8) mixture per square yard of nursery bed.
- (c) Stumps shaded with collar pots against stumps shaded with fish bean. (*Tephrosia* sp.)
- (d) no starter fertilizer against 1 oz. fertilizer mixture applied adjacent to the stump immediately after planting.
- (e) a 4 ins. tall stump against an 8 ins. tall stump.

At the end of the rains a count was made of the number of deaths. Certain significant differences were found within treatments at each site and there are differences between treatments at the two sites. A final count will be made in November or December, 1953, at the end of the dry season, when the danger period should be virtually over.

TABLE XVI: PERCENTAGE OF DEATHS, AT THE END OF THE FIRST RAINS, OF THE NUMBER OF STUMPS ORIGINALLY PLANTED

	Age (a)		Nursery Fertilizer (b)		Shade (c)		Starter Fertilizer (d)		Size of Stump (e)	
	18 m.	30 m.	nil	1 oz.	Pots	Fish bean	nil	1 oz.	4 ins.	8 ins.
Mimosa ..	3.2%	2.6%	3.7%	2.1%	2.3%	3.5%	2.6%	3.2%	2.5%	3.3%
Tung Station	4.5%	1.3%	2.4%	2.1%	3.7%	3.7%	3.0%	2.8%	3.2%	2.6%
L.S.D.			Mimosa		P at 0.05 = 1.0%		P at 0.01 = 1.4%			
L.S.D.			Tung Station		P at 0.05 = 1.1%		P at 0.01 = 1.5%			

At both sites an equal total percentage of deaths were obtained and pots gave significantly more protection than did fish bean (*Tephrosia* sp.). At the Tung Station the older stumps had significantly less deaths than the younger stumps, and at Mimosa, nursery fertilizer was a help.

(iii) *Stem Diameter, Root Weight and Survival, Mimosa and Tung Station:*

In 1951-52 a high correlation coefficient of + 0.98 between stem diameter and root weight of 18 month old stumps was recorded (see Nursery Experiments (iv) above). Similar measurements were made in 1953 on 300, thirty month old stumps taken from the same beds occupied by the previous seasons, sample, and from immediately adjacent plots. The two sets were, therefore, as far as possible from the same population, grown under the same conditions and differing only in age.

A mean correlation coefficient of + 0.83 was obtained and is highly significant at a probability greater than $P = 0.01$. From these two sets of measurements it appears that stem diameter is a good indication of root weight of stumps up to 30 months old.

The stem diameters of all the stumps planted in the survival experiments were measured immediately after planting and six months later deaths were plotted against stump diameter. This data is summarized in Table XVII.

TABLE XVII: STEM DIAMETER AND PERCENTAGE DEATHS OF NEWLY PLANTED STUMPS

Site	Diameter group in 1/16 ins.									
		3 to 5		6 to 8		9 to 11		12 to 14		15 and above
Mimosa ..	..	7.6%	..	3.8%	..	1.6%	..	0.0%	..	None
Tung Station	..	9.0%	..	3.5%	..	1.6%	..	2.3%	..	None
Mean of all data	..	8.1%	..	3.6%	..	1.6%	..	1.5%	..	None

The percentage of deaths is negatively correlated with stem diameter. At this early stage in the life of the experiment no hard and fast ruling will be given as to optimum stump diameter but it is possible that the practical criterion of not less than a "pencil width" is perhaps on the small side. There is no proof as yet of the causes of death, although it is tempting to regard food reserves within the transplanted stump as being important.

(iv) *Development of New Root Systems after Planting out:*

In support of the above work on establishment in the field, the newly developing root systems from 18 and 30 month old transplanted stumps are being studied. This work is not completed but up to six months after planting the following notes were recorded. Callusing of broken root ends must begin almost immediately after planting and was first noticed at the end of the first week; occlusion being complete at about six weeks after planting. Root initials were first noticed two weeks after planting, mainly emerging from callus rings, and six months later, a young but well-formed root system was obtained with well-defined penetrating roots and laterals, both bearing masses of fine proliferating feeding rootlets. At this stage penetrating roots, averaging about 10 ins. in depth below the old tap root end, were already well into the subsoil and laterals spread radially to an average of about 8 ins. from the tap root. Thirty month old stumps bore more roots than did 18 month stumps though the individual roots were no bigger.

Very noticeable was the fact that for both ages of stumps most of the new roots grew from the bottom one-third of the old tap root and this should be borne in mind when starter fertilizers are applied at planting.

PRUNING EXPERIMENTS

(i) *Length of Pruning Cycle and Type of Prune, Swazi:*

This experiment on poor Indian jat tea completed its fourth successive three-year cycle and compares the following treatments:—

- clean prune on a two-year cycle,
- clean prune on a two-year cycle,
- clean prune on a three-year cycle,
- cut across prune with no cleaning out on an annual cycle,
- cut across prune with no cleaning out on two year cycle,
- cut across prune annually with cleaning out of centre.

The frame-work of the annually cleaned treatments had developed into thin whippy over-high branches and it was necessary at pruning time to prune down. Yields in lbs. made tea per acre for the fourth cycle are given in Table XVIII.

TABLE XVIII: EFFECT ON YIELDS OF PRUNING TYPE AND LENGTH OF PRUNING CYCLE FOR THE SEASONS 1950-51 TO 1952-53

(in lbs. made tea)										L.S.D.	
Clean prune			Cut across Prune							P = 0.05	
Yearly	2 Yearly	3 Yearly	Yearly	2 Yearly	Centering						
2,945	3,338	3,586	3,359	3,517	3,414					176	

The three-year clean prune has yielded significantly more than either of the remaining two clean-pruned cycles; and the two yearly cycle significantly more than the annual clean prune. The difference between cut across treatments are not significant and all have yielded significantly more than the annual prune. The annually clean pruned plots are now beginning to look in a very sorry state and under normal estate practice the remedy would be to extend the pruning cycle and pluck the bushes lightly. The experimental treatments, of course, will be maintained. Table XIX records total yields in lbs. made tea for the twelve years, 1941-1953.

TABLE XIX: TOTAL YIELDS FOR FOUR CONSECUTIVE THREE YEARLY CYCLES (in lbs. made tea and inches of rain)

Clean prune			Cut across				
Yearly	2 Yearly	3 Yearly	Yearly	2 Yearly	Centering		
13,868	15,246	14,821	14,031	14,059	13,800		

This experiment, after four consecutive three-year cycles, is still showing systematic changes in yield responses. In the early years the shorter and cut across cycles tended to out-yield the longer and clean pruned treatments, but a gradual change is taking place and now it appears that the position is slowly being reversed in favour of longer cycles and clean pruning.

The twelve-year data has been used to calculate mean yields in lbs. made tea per acre for each year within the various pruning cycles. As rainfall has such a pronounced effect on seasonal yields, the mean rainfall in inches for each year is included.

TABLE XX: MEAN YEARLY YIELD RESPONSES THROUGHOUT DIFFERENT PRUNING CYCLES (in lbs. made tea)

Year in Cycle		Clean prune								Cut across			
		Yearly		2 Yearly		3 Yearly		Yearly		2 Yearly		Centering	
		lb.	rain	lb.	rain	lb.	rain	lb.	rain	lb.	rain	lb.	rain
First Year..	..	1156	72.63	1305	72.35	1365	70.11	1169	72.63	1197	72.35	1150	72.63
Second Year	..	—	—	1236	72.90	1405	72.68	—	—	1144	72.90	—	—
Third Year	..	—	—	—	—	927	75.09	—	—	—	—	—	—

From these data it would appear that rainfall would cause little bias in mean yields. The pattern of yields for the three yearly cycle follows that in Ceylon termed by Eden the "early maximum pattern", whereby yields rise to a maximum during the first half of the cycle then drop away during the second half.

(ii) *Pruning Cycles on Local Jat Tea: Thornwood Estate:*

This experiment has completed its first year of treatments and there is nothing to report on pruning effects. Reports on tipping effects and fertilizer responses will be found elsewhere.

TIPPING EXPERIMENTS

(i) *Height of Tipping Experiment, Indian Jat Tea—Swazi:*

This experiment, comparing 4, 6 and 8 ins. tipping on Indian jat tea was pruned in June, having completed a three-year cycle. The past season's yields in lbs. made tea per acre and the total yields for the three year cycle are recorded in Table XXI.

TABLE XXI: EFFECT OF TIPPING HEIGHT ON YIELDS—SWAZI
(in lbs. made tea)

<i>Tipping height</i>	<i>4 ins.</i>	<i>6 ins.</i>	<i>8 ins.</i>	<i>L.S.D. P=0.05</i>
1952-53 season's yield ..	1,083 ..	1,073 ..	1,140 ..	None
Total for three years ..	5,416 ..	5,330 ..	5,386 ..	None

There are no significant differences in yields due to tipping heights either for the past season or for the cycle as a whole. Small but significant losses in crop were obtained during the first year at the tipping and table formation stage for each upward step in tipping height; thereafter no significant differences have been obtained in plucking yields. The early significant losses have been made good over the three years.

(ii) *Tipping Local Jat Tea, Thornwood Estate:*

The three cubed factorial experiment at Thornwood has one treatment comparing tipping at 2, 4 and 6 ins. above the pruning cut. Yields in lbs. made tea per acre for the 1952-53 season (the first season of treatments) are given in Table XXII.

TABLE XXII: EFFECTS ON YIELDS OF TIPPING HEIGHT, THORNWOOD
(in lbs. made tea)

<i>Tipping height</i>	<i>2 ins.</i>	<i>4 ins.</i>	<i>6 ins.</i>	<i>L.S.D. P=0.05</i>
Tipping phase ..	185 ..	167 ..	153 ..	11
Whole season ..	1,250 ..	1,195 ..	1,197 ..	None

Over the whole season, July to June, there has been no significant losses in crop due to increasing the tipping height. During the early part of the season, July to November at the tipping and table forming stage, a significant loss in crop was obtained for each upward step in tipping height. These results parallel so far those obtained for Indian tea reported above.

(iii) *Effect of Tipping Height on Wood Formation:*

At both Swazi and Thornwood observations were made after pruning on the development of new wood growth as a result of the previous tipping height.

It was possible to take measurements at Swazi of the diameters of the cut ends of branches immediately after pruning and this data, recorded in Table XXIII, shows that increasing the tipping height resulted in significantly bigger branches being formed within the bush framework.

TABLE XXIII: EFFECT ON BRANCH DIAMETERS IN INCHES, OF THREE TIPPING HEIGHTS

<i>Tipping height</i>	<i>4 ins.</i>	<i>6 ins.</i>	<i>8 ins.</i>	<i>L.S.D. P=0.05</i>
Mean diameter—ins. ..	0.32 ..	0.33 ..	0.34 ..	0.01

At Thornwood it was not possible to take diameter measurements, but a team of three independent observers gave marks to the size of wood within the newly pruned plots. Excepting one disagreement between two observers over two plots within one block, all awarded similar marks to all other plots. The team, except for the single exception, awarded without disagreement the highest number of marks to the 6 ins. tip, the lowest to the 2 ins. tip and intermediary marks to the 4 ins. tip. The award of marks in this order and with almost unanimous agreement make the observation highly reliable that each step up in the tipping height results in bigger wood formation within the bush framework.

PLUCKING EXPERIMENTS

Plucking on Six, Ten and Fourteen Day Rounds, Swazi:

The experiment comparing plucking on six, ten and fourteen day rounds was continued, and completed the first year of its first three year cycle. The plots are now pruned. As in previous years the standard of plucking was sufficiently uniform as to cause no bias in treatment yields. Yields in lbs. made tea per acre for the past season and total yields for the three years are given in Table XXIV.

TABLE XXIV: EFFECT ON YIELDS OF INCREASING THE LENGTH OF PLUCKING ROUND
(in lbs. made tea)

<i>Length of round</i>	<i>6 day</i>	<i>10 day</i>	<i>14 day</i>	<i>L.S.D. P=0.05</i>
1952-53 season ..	799 ..	710 ..	625 ..	124
Three year totals ..	3,632 ..	3,449 ..	3,077 ..	289

Over the 1952-53 season the six-day round has yielded significantly more crop than the fourteen-day round, there being no other significant differences. For the three year totals both the six and ten-day rounds have yielded significantly more crop than the fourteen-day round, there being no significant differences between the former. Based on three years' results, there is an indication that in a vigorous crop year the response to shorter rounds is more pronounced than in a poor crop season. This might be expected, but it will require more seasonal data before it can be fully proved.

The effect of the length of the plucking round on quality was studied in 1952 by taking leaf samples at each pluck, and though attempts were made to enforce a standard pluck, Table XXV shows that the plucked leaf deteriorated in quality for each rise in the length of round.

TABLE XXV: EFFECT OF LENGTH OF ROUND ON QUALITY OF PLUCKED LEAF

	<i>Length of Round</i>	<i>6 day</i>	<i>10 day</i>	<i>14 day</i>	<i>L.S.D. P=0.05</i>
Mean per cent. make-up of leaf samples	2 leaves 1 bud	59.8%	53.8%	51.2%	3.1%
	4 leaves 1 bud	3.0%	4.5%	5.0%	0.7%
	3 leaves 1 bud	37.8%	41.6%	43.8%	2.4%

MANURING OF TEA EXPERIMENTS

(i) *Sulphate of Ammonia at Four Rates on Mature Indian Tea, Swazi*

The experiment comparing 0, 35, 52 and 70 lbs. nitrogen per acre as straight sulphate of ammonia continued and excepting the unreliable and unpredicable penultimate rate, each rate gave a significant and nearly linear response in increasing yields. This result is in agreement with previous years. Yields in Table XXVI are in lbs. made tea per acre.

TABLE XXVI: EFFECT OF NITROGEN ON YIELDS OF MATURE INDIAN TEA, SWAZI

	<i>(in lbs. made tea)</i>								<i>L.S.D. P=0.01</i>
Lbs. nitrogen per acre	0	35	52	70					
Yield (1952-53)	257	443	448	565					105

Over the six seasons—1947-48 to 1952-53 the return in lbs. made tea (at an average of 23 per cent. of green leaf) is significantly linear ($P=0.01$) at the rates applied (excluding the unpredictable N 52) but is affected strongly by the amount and distribution of rainfall during the crop season. Table XXVII gives data in illustration of the above. Rainfall during 1948-49, though giving a higher total than that for 1950-51, was in actual fact extremely badly distributed, it being the drought year, when rainfall was very small during December, January and February. The regression coefficients for response of nitrogen to rainfall as measured by yield are + 0.0962 and + 0.0876 for N 35 and N 70 respectively, the former just failing to reach significance at P 0.05 and the latter being just significant. There being no significant differences between the two.

TABLE XXVII: EFFECT OF RAINFALL ON RESPONSE TO NITROGEN AS MEASURED BY YIELD

<i>Season</i>	<i>Rainfall November-April</i>	<i>Response in lbs. made tea over control and over N 35 respectively for each lb. of Nitrogen applied</i>	
		<i>N 35</i>	<i>N 70</i>
1947-48	76.51 ins.	5.8	6.6
1948-49	45.38 „	0.5	0.7
1949-50	60.90 „	5.3	4.2
1950-51	40.32 „	3.5	3.5
1951-52	82.74 „	8.3	7.0
1952-53	58.40 „	5.3	4.2
Mean response of six seasons		4.8	4.4

(ii) *Three Cubed Factorial N.P.K. on Mature Indian Tea, Swazi:*

This experiment was started in 1952 on poor Indian jat tea, 17 years old, unshaded, and in its third year from prune. The results in 1953 repeated those of 1952 in that a significant increase in crop was obtained from nitrogen, but no significant differences were obtained due to phosphates or potash. Table XXVIII records yields in lbs. of made tea per acre against treatments, which are expressed in lbs. of nutrient per acre.

TABLE XXVIII: EFFECT OF N.P.K. ON YIELDS AT SWAZI

	<i>(in lbs. made tea per acre)</i>											
<i>Treatment</i>	<i>Nitrogen (N)</i>				<i>Phosphate (P₂O₅)</i>				<i>Potash (K₂O)</i>			
Nutrient level (in lbs.)	40	80	120		0	30	60		0	30	60	
Yield	440	588	745		589	576	608		580	611	582	
L.S.D.	P at 0.01 = 92				None				None			

No further comment will be made on yield responses at this early stage in the life of the experiment.

(iii) *Three Cubed Factorial N.P.K. on Mature Indian Tea, Mianga Estate:*

An experiment with exactly similar treatments to that at Swazi completed its first year of experimental treatments at Mianga Estate in the Cholo District. Yields in lbs. made tea per acre against treatments are given in Table XXIX.

TABLE XXIX: EFFECT OF N.P.K. ON YIELDS AT MIANGA ESTATE, CHOLO

(in lbs. made tea per acre)

Treatment	Nitrogen (N)			Phosphate (P_2O_5)			Potash (K_2O)		
Nutrient level (in lbs.)	..	40	80	120	..	0	30	60	..
Yield	..	556	630	747	..	656	642	635	..
L.S.D.	..	P at 0.01=71			..	None			..

Nitrogen has given a significant increase in crop for each upward step and there are no significant differences due to phosphate or potash applications.

(iv) *Sulphate of Ammonia on Local Jat Tea, Thornwood Estate, Mlanje:*

The three cubed experiment on local jat mentioned above has three treatments comparing nitrogen at 40, 80 and 120 lbs. per acre applied as straight sulphate of ammonia. For each upward step in nitrogen a significant increase was obtained as shown in Table XXX; yields are in lbs. made tea per acre.

TABLE XXX: EFFECT OF NITROGEN ON YIELDS OF LOCAL JAT TEA, THORNWOOD ESTATE, MLANJE

(in lbs. made tea per acre)

Nitrogen level (in lbs.)	..	40	..	80	..	120	..	L.S.D.
Yield	..	1,066	..	1,218	..	1,338	..	P 0.5=108

(v) *Sulphate of Ammonia at Four Rates on Young Indian Tea, Swazi:*

This experiment continued on young Indian tea planted in 1946. Four rates of straight sulphate of ammonia supplying 0, 80, 160 and 240 lbs. of nitrogen per acre are compared. Yields for the season in lbs. made tea per acre are recorded in Table XXXI.

TABLE XXXI EFFECT OF NITROGEN ON YIELDS OF YOUNG INDIAN JAT TEA, SWAZI

(in lbs. made tea per acre)

Nitrogen level (in lbs.)	..	0	..	80	..	160	..	240	..	L.S.D.
Yield	..	765	..	851	..	855	..	889	..	P 0.05 = 77
Response in lbs. made tea for each										
1 lb. N.	..	0.0	..	0.931	..	1.06	..	0.76		

All levels of nitrogen have yielded significantly more crop than the no-nitrogen treatment, but there are no significant differences between any of the nitrogen levels. The exact interpretation of the results of the experiment over its three seasons of treatments is not clear nor is it likely to be an easy matter. Interactions between climate, length of time from prune of the tea, increasing age of the tea, cumulative effects, and the yearly fertilizer treatments themselves must cause complexities. But by taking the data as a whole it appears that tea up to seven years of age cannot make efficient use of nitrogen applications of more than 80 lbs. per acre and it is possible that the optimum economic dose is less than this. The response in lbs. made tea for 1 lb. of nitrogen applied has not yet reached the mature tea figure of about 4.5 (see above), even at the lowest nitrogen application.

(vi) *Time of Application of Fertilizer, Swazi:*

(a) The experiment comparing whole or split doses of sulphate of ammonia at the beginning of and during the rains continued and no significant differences in total seasonal yields resulted. As in previous seasons a first response in yield was obtained at about three weeks after fertilizer application. An early November whole application has the disadvantage that it results in an early burst of crop which may be difficult to pluck with the usual early season shortages of labour and if plucked, difficult to manage in a factory where space is limited. The same total dose, split equally between an early November and an early January dressing gives a better crop distribution and thereby should ease plucking and factory problems, but the disadvantages are to find extra labour for applying fertilizers in January, and the difficulty of handling fertilizer in this normally wet month. If it is possible, the latter method should be preferred; if not, a late dry season date, as near to November as possible, should be chosen as there is evidence that applications in the early dry season lose their effect (see below).

(b) The experiment comparing four rates of sulphate of ammonia on mature Indian jat tea at Swazi, reported above, was increased in scope in the 1952-53 season by splitting the plot and applying the fertilizer in two applications; in July, during the dry season, and in November, just before the break of the main rains. The November application gave a highly significant increase in crop over the July dressing ($P = 0.01$).

(vii) *Nitrogen or Sulphur:*

Tea yellows is cured by applications on sulphur either as the element, or as sulphate. It may be that some of the response obtained with sulphate of ammonia might be due in part to the sulphate radical and in part to the ammonium. An experiment at Swazi comparing three different nitrogenous fertilizers, with and without sulphur, completed its first year of treatments in 1953 with no significant differences between yields. This is partly to be expected because all plots prior to this year were receiving 80 lbs. of nitrogen as straight sulphate of ammonia which, judging from previous work by Leach, should have residual effects lasting approximately two years. The unfertilized control is gradually losing ground.

SPACING OF TEA

(i) *Four Spacings, Swazi:*

This experiment, now 14 years old, compares four spacings of tea which are:—

- $3\frac{1}{2} \times 3\frac{1}{2}$ feet square, 3,550 bushes per acre
- 4×4 feet square, 2,720 bushes per acre
- $4\frac{1}{2} \times 4\frac{1}{2}$ feet square, 2,150 bushes per acre
- 5×5 feet square, 1,740 bushes per acre.

The results for the past season confirm previous work that under the conditions of this experiment significant differences between yields were regularly found up to ten years after planting but thereafter the yield differences were not always significant. The yields of the mature tea do in fact increase directly as the number of bushes per acre increase and the differences in yield between the closest spacing and the widest amounts to about 30 per cent. of the latter. The standard error of this experiment is high and it is believed that with a better experimental design the yield differences of this order would be significant. In past seasons, whilst the tea has been mature, the differences though not always significant, have been systematically maintained and fall on approximately a straight line of spacing plotted against yield. It is, therefore, believed that spacing, within the limits of the populations used in this experiment, does in fact have a direct bearing on the yields of mature tea and that on the average, doubling the number of plants per acre gives 30 per cent. more yield.

(ii) *Spacings and Differential Fertilizers, Mimosa:*

There are no data ready for report from this factorial experiment comparing four different spacings and four rates of application of sulphate of ammonia.

WEEDS AND WEEDING

(i) *Effect of Weeds and Grasses on the Yield of Tea, Swazi:*

The experiment comparing the effects of weeds and grasses on the yield of mature tea continued and no significant differences were obtained between treatment yields. Yields as a percentage of the clean weeded treatment, are listed below and it is thought that the failure to find significance is due to the standard error of the experiment being high.

							Per cent.
Clean weeded	..	..	..	..	..	..	100.0
Unweeded	..	..	..	..	..	..	90.1
Dhub grass (<i>Cynodon dactylon</i>) planted and encouraged	..	..	..	..	..	..	87.1
Dicotyledonous weeds left, grass removed	..	..	..	..	..	..	85.6
Natural grasses left, Dicotyledonous weeds removed	..	..	..	..	..	..	83.4
Seychelles grass (<i>Panicum umbellatum</i>) planted and encouraged	...	...	...	...	...	...	76.6

The order of yields and their percentage comparisons follow very closely those of previous seasons.

(ii) *Effect of N.P.K. on Weed Growth, Swazi:*

Some preliminary data on the effect of the three major nutrients on weed growth under mature tea was obtained from the three cubed fertilizer experiment at Swazi. The data is not yet ready for formal analysis but is indicating that increasing doses of nitrogen and phosphate increase total weed growth (dicotyledons plus monocotyledons), phosphate more so than nitrogen. Potash might have little effect on total weed growth. Increasing doses of nitrogen appear to increase the ratio of grass growth (monocotyledons) to weed growth (dicotyledons) whereas increasing doses of phosphate and potash reverse this ratio.

PERMANENT SHADING OF MATURE TEA

(i) *Shade Trees and Fertilizers, Mimosa:*

The shade trees were planted in this statistically designed experiment. No differential fertilizers will be applied until after calibration of plot yields is complete.

(ii) *Observation Plots, Swazi:*

Records continued to be taken from the observation plots shaded with *Albizia glabrescens* and from immediately adjacent unshaded tea similar in jat, age and treatment to the former. Half of each plot received for the second year sulphate of ammonia supplying 80 lbs. of nitrogen per acre and the other half no fertilizer. Yields in lbs. made tea per acre are reported in Table XXXII.

TABLE XXXII: EFFECT ON YIELDS OF SHADE, WITH OR WITHOUT NITROGEN
(in lbs. made tea per acre)

			With shade		Without shade		Nitrogen mean yield
With nitrogen	..	..	710	..	685	..	698
Without nitrogen	..	..	511	..	444	..	478
Shade, mean yield	..	..	611	..	565		

For the fourth successive season record shade has given an increased crop over no shade, though the response is not as large in the 1952-53 season as in previous ones. Nitrogen has given an increased crop for both shade and no shade, the response being greater under the latter.

MISCELLANEOUS

A lot of work, some of it of a fundamental nature, was undertaken in investigating a mal-growth of tea on one estate. Causes and cures have been suggested but the latter are of a long term nature and no immediate result is available. It is hoped to obtain permission to publish the results of many of the analyses as these will be of interest to other research stations.

(ii) A start has been made with drawing rainfall maps of the tea areas.

(iii) The soil survey of tea and tung areas being jointly undertaken with the Agricultural Chemist makes steady progress but inherently it is a long and tedious job.

(iv) The Agricultural Chemist has made many analyses of soils from various experimental plots during the year. There is a tendency for these results to show fairly wide variation and with a view to overcoming this, systematic work has started on trying to discover a reliable soil sampling technique for experimental plots.

(v) A field experiment comparing six different methods of reducing termite damage on newly planted stumps is not meeting with much success because of the usual errors associated with insect experiments, though a Chlordane compound appears to be the best so far. Certainly Chlordane is extremely effective in protecting collar shades made of bracken against termite destruction.

PLANT PATHOLOGY

The Nyasaland tea belts have maintained their good reputation as far as disease is concerned and only three diseases have been reported this season.

1. *Armillaria mellea*. This serious root disease has appeared in new clearings and in several cases has resulted in severe losses. This well-known disease and its control has been described in detail in numerous reports and pamphlets.

2. *Helicobasidium compactum*. This is a "Violet Root Rot" and was first described in this country by R. Leach. It appears to have been uncommon, but this season it has appeared in several nurseries on widely separated estates in the Mlanje District. Infected seedlings planted out as stumps are liable to die suddenly, and this has in fact happened on one estate where losses have been large in three different clearings. It would appear that this disease is assuming a more serious role in this country.

3. *Septobasidium sp.* This curious fungus, which is parasitic on certain scale insects sometimes found on the frame of the tea bush, was recorded for the first time from Cholo. Commonly known in Ceylon and India as "Velvet Blight" this fungus appears as a brown or purple-black growth covering parts of the bush frame. It is uncommon and does not appear to be harmful.

PESTS

Tea Mosquito Bug (Helopeltis bergrothi). The season under review has seen a marked increase in this troublesome pest, and control measures by means of 50 per cent. D.D.T. as a wettable powder have been necessary on several estates. The effects of the bug on the formation of the frame of young tea can be very grave and control measures should be a routine matter as soon as the pest is noticed. Several years ago it was forecast that this pest might assume epidemic proportions in this country, and the incidence in Mlanje this season certainly makes this a possibility.

Red Spider (Metatetranychus bioculatus). A perennial pest on tea, this mite has made an early appearance, probably due to the prolonged and early dry spells of weather in May and June. Control by sulphur dust and lime sulphur is being practised at Mimosa, and some new ovicides are due to be tested. This problem of egg destruction has not been tried so far in this country.

Systatis smei. A leaf-eating beetle and normally present on weeds caused some damage to young tea in one area. Effective control was achieved by means of 50 per cent. D.D.T. wettable powder.

The gradually increasing acreage of Indian tea with its longer pruning cycles must be expected to cause an increase in the incidence of both pests and diseases in Nyasaland.

- References:** R. LEACH. "Biological Control and Ecology of *Armillaria mellea* (Vahe) FR" Transactions of the British Mycological Society Vol. 23, Pt. IV, Dec., 1939.
T. EDEN. "The Control of *Armillaria Root Disease in Tea*" Pamphlet No. 3 of the T.R.I. of East Africa.
E. HAISWORTH. "Tea Pests and Diseases and their Control", Heffers, Cambridge.

TUNG

The following report covers the two seasons 1951-52 and 1952-53.

BUDDED TUNG VERSUS SEEDLINGS

In the experiment laid down in 1940 the results for 1952 once again provide overwhelming evidence that in *Aleurites montana* budded trees out-yield seedlings on an orchard scale. *Montana* budded on *montana* has been consistently superior to *montana* on *fordii*, to selected seed and to unselected seed. A combined analysis for 1950, 1951-1952 showed *montana* to be superior to *montana* on *fordii* which in turn was superior to selected seedlings which latter were superior to unselected seedlings, all significant at $P=0.01$.

In 1953 this order was slightly varied, though the superiority of *montana* on *montana* remains, as is shown in Table XXXIII.

TABLE XXXIII: BUDDED TUNG VERSUS SEEDLINGS, 1953
(Yields in lbs. air dry seed per tree)

Treatment					Clones				Means	
					M8	M13	H14	F9		
Montana stock ..	..	..	..	..	27.2	20.4	20.1	15.5	20.8	
Fordii stock ..	..	..	..	..	16.1	18.6	11.3	14.9	15.2	
Selected seedlings ..	..	..	..	..	21.8	17.9	23.7	17.1	20.3	
Unselected seedlings (no clones) ..	..	..	..	..	—	—	—	—	14.7	
Means ..	..	..	..	..	21.6	19.0	18.6	15.9		
L.S.D.					P = 0.05		4.1	P = 0.01		5.6

Yields were very low in this year, about 45 per cent. less than in 1952 and there were no significant differences between clones.

CLONAL TRIALS

Yields were universally high in 1952 and this was entirely in line with the habit of biennial bearing which had been noted in previous years. This phenomenon becomes much more pronounced as trees approach maturity and a good indication of the extent of it is afforded by the annual mean yields of a field of trees planted in 1940.

1948 mean yield	18.2 lbs. seed per tree	=	1,019 lbs./acre
1949	" " 24.7 " " " "	=	1,383 lbs./acre
1950	" " 42.2 " " " "	=	2,363 lbs./acre
1951	" " 22.3 " " " "	=	1,249 lbs./acre
1952	" " 55.4 " " " "	=	3,102 lbs./acre
1953	" " 16.2 " " " "	=	893 lbs./acre

The 1953 crop was exceptionally low, not only on this experiment but on all tung plantings.

The four best clones of the original selections had reached an interesting stage by 1952. They are clones M13 and M8 which are vigorous and make big erect trees which come into heavy bearing comparatively slowly (A-type), and clones 14 and 10 which are precocious, bear heavily at an early age and make smaller trees of an umbrella shape (B-type). It was always anticipated that while in the early years the B-types would outyield the A-types, the development of the A-types would eventually surpass the others. In the heavy crop of 1950 M8 and M13 outyielded 10 and 14 for the first time, in 1951 this was reversed; but in 1952 the two A-types were again superior. It seems, therefore, that for clones 10 and 14 maturity is reached in about the tenth year, whereas M8 and M13 were still increasing. The figures in Table XXXIV below give the total mean yields per tree of these four clones up to the ninth year and for the next three years, and show how the A-types are beginning to catch up.

TABLE XXXIV: CLONAL TRIALS
(Yields in lbs. air dry seed)

Years		Clones							
		M13		M8		14		10	
		Per tree	Per acre	Per tree	Per acre	Per tree	Per acre	Per tree	Per acre
December, 1940 ..	..	Planted as budded stumps							
1943-1949 ..	..	98.3	5,505	85.4	4,782	108.4	6,070	118.0	6,608
1950-1952 ..	..	129.4	7,246	134.0	7,504	124.7	6,983	132.7	7,431
Total up to 1952 ..	..	227.7	12,751	219.4	12,286	233.1	13,053	250.7	14,039
1953 ..	..	17.9	985	20.3	1,117	18.1	996	19.6	1,078
Total up to 1953 ..	..	245.6	13,736	239.7	13,403	251.2	14,049	270.3	15,117

As yields were so low in 1953 (an " off " season) it is difficult to draw further conclusions on the performance of the two best A-type clones, M8 and M13 and the B-type clones 14 and 10. These all still cropped better than the A-types 04, N24 and H14 and the B-type F9; but there was no further evidence that the A-types were beginning to outyield the B-types.

Of the younger clones on trial at the station the following are the most promising:—G108, G56, G96, G112, F225, E49, E50, E57, E369, E424, E464, E484, A1A and V17. All showed biennial bearing tendencies.

A trial is being laid out on a nearby estate of eleven promising A-type seedlings to assess against the A-type M8 their performance as mother trees.

Aleurites fordii, although a poor yielder under tropical conditions and a smaller tree than *A. montana*, has never lost its attraction to the planter because its oil is more acceptable to the trade, it is a tree which appears to stand up to less care than *montana* and its nut is easier to hull.

On the station an experiment is being planted up with crossed and selfed B-type seedlings of *Aleurites montana* to be compared with *A. fordii* seedlings raised from American seed imported by one of the estates. Some of the *montana* clones may be particularly precocious and would be suitable for hedge-planting, or for a rapid expansion of oil production in an emergency.

The same estate which imported the *fordii* varieties is planting a similar experiment to the above using *montana* clone 10 budded on *montana* as a control. On another field a collection of hitherto neglected *fordii* seedlings is being given more careful attention and promising trees being carefully recorded with a view to later propagation.

INTERCROPPING AND COVER CROPS

An experiment planted in January, 1945, compares (with six replications), the following intercropping methods in their effect on tung.

Soya beans every year.

Maize and a legume alternate years.

Permanent cover crop of *Glycine javanica*.

Grass and weed cover slashed twice a year, and mulched round the trees with 1 lb. sulphate of ammonia to each tree.

Yields in this field have always been disappointingly low, though in 1952, in common with all tung, there was a big improvement. Even so the mean yield of 16.4 lbs. seed per tree for trees 7½ years old is poor. Analysis of the results for 1952 (see Table XXXV) showed again that the *Glycine* cover crop was significantly worse than either of the first two treatments, (P=0.01). The maize treatment was also superior to the weeds treatment (P=0.05). In 1953 there were no significant differences between the treatments.

TABLE XXXV: INTERCROPPING TRIAL

(Mean Yields in lbs. air dry seed per acre)

Years					Treatments					
					Soya	Maize/ Legume	Glycine javanica	Grass S/A	Sig. Difference	
									P=0.05	P=0.01
1952	..	..	..	..	1,101	1,220	497	828	389	538
1949-1952	..	..	..	..	2,098	2,223	1,100	1,707	301	418

This field had its indigenous timber removed without ringbarking before the Department acquired the land, and deaths of tung due to *Armillaria mellea* occur each year and the vacancies and supplies in this experiment now total 13.3 per cent. of the whole. As the sub-plots are single trees of 36 different clones it is impossible to adopt any missing plot technique for substituting the missing figures. In the analysis carried out vacancies and supplies have been omitted altogether and the treatment effects have been calculated on the means of the remaining figures. The results so obtained cannot be accurate but it is felt that they still give a reasonable picture; but this experiment could profitably be repeated using more than one tree per plot and a smaller number of clones per block.

In another part of the same field pigeon pea (*Cajanus sp.*), planted in rows 3 ft. apart, provides an excellent intercrop cum cover crop. At the beginning of the growing season it is lopped to within 15 to 18 ins. from the ground, the trimmings being used as a mulch. Both pigeon pea and fish bean (*Tephrosia sp.*), which should receive similar treatment, depress undesirable weeds and are valuable providers of nitrogen. It is, however, important to lop them annually in October; on estates where this is neglected it is apparent that the branches can shade young trees or the dwarf clones of tung, and must undoubtedly reduce the total crop.

FERTILIZERS TRIALS—N.P.K.

The original N.P.K. factorial fertilizer experiment was started at this Station in December, 1946, (on trees planted in December, 1943) and continued until December, 1950. The treatments were 2 lbs. sulphate of ammonia, 2 lbs. superphosphate and 1 lb. muriate of potash per tree. From 1947 to 1950 the treatments were the same except that the sulphate of ammonia was increased to 3 lbs. per tree. The effect of each application only becomes apparent on the crop harvested 20 months later so that the 1952 crop is the last one to show a direct response, though it may be that a residual effect will continue for some time if only as a result of the increased growth of the trees receiving nitrogen. As has always been the case at this station the only treatment effective in 1952 was sulphate of ammonia. This gave a significant increase in yield (P=0.01) of 43 per cent. as compared with no nitrogen. The residual effect for nitrogen continued in 1953, when although yields were generally very low, there was still a significant (P=0.05) increase in yield of 25 per cent. for the nitrogen treatments. Phosphate and potash have never given significant results.

The decision to abandon further treatments on this field and to begin a factorial 2₅ experiment incorporating copper and zinc as well as NP and K was explained in the 1951 Report. The applications are:—

Sulphate of ammonia	..	..	..	3	lbs. per tree
Phosphate (Raw Rock/Supers. mixture)	..	2	..	..	..
Muriate of potash	..	1	..	..	..
Zinc sulphate	..	3	..	..	ozs. ..
Copper sulphate	..	..	..	1/2	oz. ..

The treatments were first applied at the end of October, 1950, so that the crop harvested in 1952 was the first which could be affected. As was to be expected the first year treatments showed no significant results, nor were there any significant responses in 1953.

A replication of this trial was started at the same time on a private estate on trees two or three years older. Here also, no significant results were obtained in 1952, but in 1953 a significant response (at P=0.01) was obtained from nitrogen with an increase of 14.4 per cent. over no nitrogen. Furthermore, it was noticeable that where nitrogen had been applied, these trees retained their leaves for a longer period. Zinc gave an increase of yield significant at P=0.05. This is not surprising since from soil and leaf analyses the area had previously been shown to be so low in zinc that deficiency symptoms were common.

FERTILIZER TRIALS—NPK WITH DUNG

The most interesting results with fertilizers are beginning to emerge from an experiment started in November, 1948, on the same estate mentioned above. The soil had been badly eroded in a succession of tobacco crops prior to planting the tung in 145 and the trees were not thrifty. The treatments were:—

N — Sulphate of ammonia	..	3	lbs. per tree
P — Superphosphate	..	3	
K — Muriate of potash	..	1	
D — Kraal Manure	..	100	

As explained in the 1951 Report the only significant main effect in that year was from nitrogen (P=0.01). The first order interactions N×P and P×D and the second order interaction N×K×D (all significant at (P=0.05) were therefore to be regarded with caution. The 1952-53 results show N again highly significant and this, taken with the effect of N in the experiment mentioned above, can be accepted with confidence. For the first time, however, the main effects of P and D have achieved significance at probabilities of 5 per cent. and 1 per cent. respectively, and the first order interaction P×D is again significant, (P=0.05). It seems likely therefore, that the level of P available in the soil is now a limiting factor so that applications of inorganic phosphate increases the yield significantly. Whether the effect of the dung is due to the nitrogen, the phosphate, or the organic matter added to the soil it is impossible to say; but in view of the fact that the first order interactions N×P and N×D were less than the mean (though not significantly so), it is essential to wait for the results of the next few years before accepting the effects of P and D as proved. In order to get an overall picture the combined yields of 1950-1951-1952 were analysed and the only significant results were N (P=0.01) and D (P=0.05). The results for 1952 and for the combined yields are given in Table XXXV. The only first order interaction which was significant (P=0.05) was N×P, but this produced a depressing effect, and indicates that conclusions cannot yet be drawn.

TABLE XXXV. NPK WITH DUNG TRIAL
(Yields in lbs. air dry seed per acre)

Years	Treatment Effects							Sig. Diff.	
	Exptal Mean	N	P	D	PD	NP	ND	P=0.05	P=0.01
1952 ..	997.6	210.6	105.7	127.9	91.6	34.1	50.3	87.8	117.3
1950-52 ..	2,097.6	331.2	141.3	187.5	169.6	122.2	125.3	183.7	245.4

The particular point of interest regarding these results lies in the fact that analyses of the soil of this area have shown that it is characterized by a very shallow A-horizon, low in organic matter and in available phosphate. As the trees continue to bear fruit, particularly as half of them are receiving stimulating dressings of nitrogen, it is to be expected that phosphate and potash supplies would be depleted. Although no response has been obtained to phosphate at the Tung Experimental Station, the soil there is in a higher state of fertility and the available phosphate is at a higher level. It will not, therefore, be surprising if the cumulative effect of phosphatic fertilizers is first found on the poorer soil. The points of similarity between this soil and those on the Vipya make the findings of this experiment of greater potential importance.

NITROGEN TRIALS

To find the optimum level of nitrogen application, an experiment was started in 1949 with treatments at 0, 2, 4 and 6 lbs. sulphate of ammonia per tree. It has not been possible to record any significant results between the various nitrogen treatments, but all levels of nitrogen gave higher yields (significant at P=0.05) than control.

TUNG DISEASES

Armillaria mellea has again attacked a number of trees and it is disturbing to find eleven new cases scattered over one field planted as long ago as 1940 and in which deaths due to this fungus have been few in past years. The previous history of this field is not known but it is thought that at least part was an area of African gardens and it has probably been impossible to ringbark all the indigenous trees. Reference has already been made above to another field planted in 1945 in which the deaths due to *Armillaria* total 11.45 per cent. A third field was abandoned for experimental purposes several years ago and another experiment was also abandoned last year for the same reason.

Botryosphaeria dieback. The Plant Pathologist was in the Protectorate for only a few months of the period covered by this report, and the investigations into the occurrence and control of this disease could not receive the same attention as in previous years. Nevertheless, we are better able now to assess the damage which it can do and the efficacy of the steps recommended in the past for its control. In the 1951 Report the following remark was made, "Results again indicated that a policy of cutting out diseased wood alone, without some measures to control the dispersal of the fungal spores, does little to reduce the incidence of the disease". It is fairly clear that this statement was somewhat premature as there was a markedly lower incidence of the disease, after the 1952 crop, on an experimental area where the pruning programme had been most carefully carried out for three years as compared with other areas which had only had one, less meticulous pruning per year. Unfortunately, recording of the effect of the disease for accurate analysis and comparison is an extremely laborious process involving labourers and recorders for weeks, and in view of the other work on hand it has not been possible to continue the recording done in previous years. But the African recorders doing the work remarked, without any previous mention of the subject being made, how much less die-back there was in this field, particularly of large branches.

The following points can now be taken as established:—

- (a) The main entry points of the pathogen are the fruit stalks of the previous season's crop. Therefore the heavier the crop the greater the incidence to be expected. The 1952 crop having been heavy the effect of persistent pruning was particularly marked.
- (b) A policy of pruning, properly carried out, while it may not seem to help much from one year to the next, will eventually be found to keep the incidence of the disease within bounds.
- (c) Young vigorously growing trees show a lower incidence than older, mature trees. Young trees on poor soil and under poor cultural conditions seem unable to put up any effective resistance when they are attacked. Well-grown trees, however, have in many cases had large branches removed but soon replace the wood lost.

Complete eradication of the disease is impossible owing to its capacity for existing on many other plants besides tung, including even a number of indigenous species. Efforts should therefore be directed to providing the best possible conditions for the trees themselves to overcome the results of infection, *i.e.*, regular cultivations and feeding plus a good standard of field hygiene.

Following the Plant Pathologist's investigations into the life cycle of the fungus it was hoped to try the effects of dusting and spraying with copper compounds. Practical difficulties and the expense involved made this impossible on any but a very small trial. Copper dusts cost approximately £14 per 300 lbs. for 20 per cent. copper and £8-18s-0d for 3.7 per cent. copper, landed at Limbe. The application would be about $\frac{3}{4}$ lb. per tree according to size and two or three dustings with 3.7 per cent. dust would probably give better results than one dusting with the higher concentration. The costs of the dust alone per application of $\frac{3}{4}$ lb. per tree is given in Table XXXVII.

TABLE XXXVII: COSTS OF COPPER DUSTS PER ACRE AT THREE QUARTER LB. PER TREE

Spacing	No. of trees per acre	lbs. dust per acre	Cost per application	
			3.7% cu.	20% cu.
			s d	s d
25 ft. sq.	70	52.5	31 6	49 0
26 ft. sq.	64.4	48.3	29 0	45 0
27 ft. sq.	60.0	45.0	27 0	42 0
28 ft. sq.	55.6	41.7	25 0	39 11
29 ft. sq.	51.8	38.9	23 4	36 3
30 ft. sq.	48.4	36.3	21 9	33 10

It will be seen that 2-3 applications of 3.7 per cent. dust would cost £2-10s to £4-10s per acre for the material alone. When the cost of labour and machines is added it is clear that it is not an economic proposition.

PESTS

One serious case of a beetle borer (*Apate indistincta* Murray, *Bostrychidae*) was reported on an estate. Channels were made in the trunk and branches up to a length of 7 ft. from the ground. The attack was confined to an area of trees which were themselves not growing very vigorously, the estate being in a low rainfall area and the trees planted on old tobacco land.

FRUIT

Mwera Hill Experiment Station continued with its programme of testing and selecting the most suitable varieties of fruit trees, and of propagating and distributing the most promising types. The investigation of the management, manurial requirements and pruning methods, suited to local conditions, was also continued and the following observations were recorded:—

GENERAL MANAGEMENT

Irrigation :

Few fruit trees can be grown well without irrigation. Water is usually expensive or scarce, and investigations on its efficient use revealed the following:—

(i) irrigation channels should be lined with bricks or stone.

(ii) irrigation should be done just before the trees are near the wilting point. This was determined by assuming that the trees were near the wilting point when the soil appeared dry at a depth of 9–12 ins. The soil at Mwera Hill is a light-medium loam and growing trees in the dry season needed approximately 4 ins. of water every three weeks.

(iii) the basin type of irrigation was found to be the most satisfactory. Trees watered by means of furrows running in the region of the root tips could not last as long as three weeks without showing signs of water shortage.

Cover Crops :

Oats have proved an effective cover crop. Sowing in early December at the rate of $1\frac{1}{2}$ ins., bushels per acre gave a good cover during the heavy rains. They were ploughed in early in March as soon as the heavy rains were over. Some rust was evident, but as a harvest of seed was not wanted this was of little importance.

Packing and Despatch of Fruits :

The transport of the fruit, once produced, will always be a problem where distances are great. To show that the problem is not insoluble, an exhibition of fruit properly packed was staged at the 1952 Lilongwe Horticultural Show. It was found that bad packing could not always be blamed for the poor condition of fruit; bad packing and handling immediately after packing was equally to blame. Peaches suffered most from bad handling but citrus suffered a high rate of damage if they were picked whilst wet or shortly after rain.

NOTES ON FRUIT VARIETIES

Citrus :

Mwera Hill at 4,800 ft. altitude has proved unsuitable for citrus trials. Propagation work has been transferred to the E.C.G.C. station at Chitala where, by the kind permission of the E.C.G.C. the Agricultural Department is given the use of a small nursery site for this purpose. *Rough Lemon* is still used as a main stock but some buddings have been done with Orange on *Sweet Orange* and Tangerine on *Cleopatra Mandarin*. It will be some years before any decision can be reached as to the superiority or otherwise of these two stocks.

The *Washington Navel Orange* can be recommended for the hill areas of Nyasaland.

STONE FRUITS

Almond :

Growth of the three varieties, *Britz*, *Jordan* and *Paper Shell* continues to be extremely good, but they have not yet come.

Apricot :

The variety *Royal* tends to produce long shoots without spurs and summer pruning is necessary. *Cape Early* needs the same treatment. It has just come into bearing and the trees have to be well irrigated when the fruit is maturing (that is October) or cracking of fruit will be serious. Apricots are the first of the stone fruits to bear.

Loquat :

Fruit is bigger where irrigation is carried out although this is not essential as the trees bear in April. The loquat could profitably be planted on a more widespread scale.

Nectarine :

Growth is satisfactory but fruiting poor. Experience elsewhere has confirmed this and it is probably useless to try growing nectarines below an altitude of 5,000 ft. in this country.

Peach :

The following varieties have been discarded as unsuitable. *Red Bird*, *Sim's* and both *Clingstones*.

Plum :

Wickson promises to give more satisfactory growth if the excess fruiting spurs are thinned out.

POME FRUITS

Apple:

To reduce the effects of delayed rest, summer pruning is essential. If this is carried out properly, no other pruning should be necessary. Thinning of the fruit is also essential if the whole crop is not to consist of "chats". Of the stocks *Merton 793* proves to be the most suitable. There has not yet been established a collection of varieties of apple which may be suitable for Nyasaland.

Pear:

Doyenne du Comice will have to be discarded as unsuitable as it suffers badly from delayed rest. *Keiffer Hybrid* is so far the best variety grown at Mvera Hill although it takes some years to come into bearing. Other varieties could be tried; double working on quince will probably give a more satisfactory tree.

Quince

For use as stocks cuttings seem to be more satisfactory than stoolbeds; the work in this direction has still to continue. *Meeches Prolific* is the best variety for fruit.

OTHER FRUITS

Fig:

White Adriatic has grown and fruited well after only 2½ years. It is a variety that can be recommended provided that one is on one's guard for a beetle which strips the bark from the young shoots and can cause serious die-back. It is easily controlled by D.D.T. emulsion.

Grape:

Isabella (Catawba) continues to bear extremely well. *Red Muscatel* is not satisfactory. Growth is poor and flowers do not set. There are other better varieties that should be tried.

Guava:

Parker's White and *Patnagola* continue to hold their own as the best varieties to be found. Vegetative propagation needs further study.

Olive:

A block of 40 trees has been planted to test reaction to a rocky and non-irrigated position. Growth for this year has been satisfactory.

Mountain Pawpaw:

Only two out of the ten trees planted were females. These two fruited well but the fruit is unattractive and clearly useless except for the canning industry.

Strawberry/Raspberry:

Rubus illecebrosus is a prolific bearer. Fruit not quite up to standard of English varieties of raspberry. The Variety *Lloyd George* makes poor growth here and would probably do better at a higher altitude.

Strawberry:

Three varieties have been planted for comparative trials against a local variety. They are *Salisbury*, *Vumba* and *Katete*.

Tree Tomato:

This fruit grows well where there is sufficient moisture in the dry season. A rather warmer climate than Mvera Hill would suit it better. It can, in fact, be used as a good indicator of the suitability of a site for citrus. Improved selections of the red and yellow varieties have been imported from New Zealand. The trees should be stopped at 18 ins. and allowed to branch at that height.

Walnut:

Walnuts planted in 1951 have produced a considerable amount of growth and, though the trees may be rather bushy, it is probable that a crop may be expected when they reach maturity.

REPORT OF THE ENTOMOLOGIST, 1953

The Entomologist assumed his duties on the 5th November, 1952. As the post had been vacant for some 18 months, considerable office and staff reorganization was necessary, and no formal experimental work was undertaken during the year under review. Most of the Entomologist's time was spent in becoming familiar with the main producing areas of the country, though of necessity at widely separated times. In many areas only one stage of growth of a crop could be seen and for further information it was necessary to depend on the reports and specimens sent in by field officers.

CROP PESTS

1. *Cotton*: Rain-grown cotton in the Lower River was again free of serious red bollworm infestation. Records of bollworm activity by means of egg counts were kept and from them it appears that activity reached its height in the Lower River in early April. At no time, however, was the infestation heavy. Activity records will be continued from year to year.

Stainers entered the crop early and reached their highest population for many seasons. Too much significance should not be attached to this high stainer population which probably represents a peak in the cyclical fluctuations of stainer numbers.

The cotton leaf worm, spiny bollworm and other lepidopterous larvae were present in insignificant numbers. Aphids, and on the winter-grown Egyptian cotton trials in the Lower River, jassids did only minor damage.

Similarly, the winter-grown Karonga cotton suffered little damage from pests, even in the areas where cotton was affected by the depleted soil moisture conditions following the early cessation of the rains in 1953.

2. *Tobacco*: Attacks of white grub and cutworms were most serious in the Zomba and Kasungu areas, but were also reported from other tobacco areas. Losses in initial stands of 70 per cent. to 80 per cent. were reported from some estates. These losses were generally never made good by supplying. Recommendations for the use of BHC soil dressings were issued and further study of the tobacco pests is being undertaken.

Leaf feeders on tobacco, notably the snowy cricket *Oecanthus brevicaudis* Sauss. were of some local importance in the Lilongwe area.

3. *Tea*: An outbreak of the thrips *Heliothrips haemorrhoidalis* Behe. was reported from an estate in the Cholo area. *Helopeltis* was active in the Mlanje District and it is interesting to note that one small outbreak of red spider followed an instance of DDT spraying for the control of *Helopeltis*. One estate in the Mlanje District reported an attack on young tea by the leaf-feeding weevil *Systates smei* Mshl. This insect is common on many wild plants and it is likely that the destruction of its weed hosts forced it into the young tea.

A species of *Microtermes* caused damage to young tea in the Mlanje District. It is possible that a slight dieback at the cut end of the stump first attracts the termites whose feeding causes further dieback and the eventual destruction of the stump. On the estate in question the practice of dipping the stumps in a Chlordane emulsion has been adopted but it is too soon yet to comment on the effectiveness of this treatment.

4. *Cereals*: Maize stalk borer was present in most gardens but caused no appreciable damage. Wheat in the Nchalo and Sombani plots showed stem swellings near ground level but no insect which could be responsible was identified.

5. *Pulses*: Local outbreaks of the bean fly *Melagromyza* sp. occurred in the Mlanje and Zomba areas. The bean leaf beetle, *Ootheca mutabilis* Sahlb. was widespread in the Southern and Central Provinces and caused considerable damage to early beans.

6. *Coffee*: The coffee areas were visited at a time when there was little insect activity. Damage by the white coffee borer, *Anthores leuconotus* Pare, was noted in the Misuku and a small amount of *Lecanium africanum* Newst. was found on young coffee at Nchenachena.

7. *Tung*: No outbreaks were recorded on this crop. Termites caused some damage on badly managed tung in the Cholo District but were otherwise unimportant. The Bostrychid *Apate indistincta* Murray, was reported from one estate.

8. *Miscellaneous*: *Hibiscus cannabinus* in the Sombani Experimental Plots was attacked by the weevil *Alcides crythropterus* Chev. A large gall is formed on the stem and effectively reduces the length of the fibres. The insect is indigenous and has been reported from several crops.

The elegant grasshopper, *Zonocerus elegans* Thumb, was active in the Lower River. A considerable measure of self help by the peasant cultivators will be necessary if this insect is to be controlled, for it is not one which lends itself well to an extermination campaign.

Queries concerning the common garden insects were dealt with but there is nothing new to report.

REPORT OF THE RESEARCH ENTOMOLOGIST

Since 1951 research investigations have been carried out on insect infestation of bulk stored grain within the Protectorate. While the programme of research has included wheat, rice and sorghum, the majority of investigations have been devoted to maize, as this cereal constitutes the most important basic foodstuff of the Nyasaland African. The range of primary, secondary, and casual pests of stored maize has been assessed. Damage incurred by these insects has been estimated by means of special surveys made in African villages, at maize buying markets and at central storage depots belonging to the Produce Marketing Board. At these same depots of the Produce Marketing Board observations have been made on the effects of different insecticides in controlling the build-up of insect infestation in large stacks of bagged maize. These treatments included:—

(a) In 1951, spraying outsides of bags of maize with 50 per cent. wettable D.D.T.

(b) In 1952 dusting of outsides of bags of maize with B.H.C. dust containing 6 per cent. Gamma-isomer.

(c) In 1953 fumigation of stacks of maize with methyl bromide.

For comparison, damage caused by insects in a stack of totally treated maize has been investigated over a storage period of 12 months.

Underground storage of shelled native maize has been included in the programme of research. The first experiment ran for 17 months over two wet seasons, and was considered a success entomologically but a failure constructionally because of the entry of moisture through hair cracks in the cement in the lower half of the pit. A second experiment is in progress and will be terminated in March, 1954.

The importance of moisture contents of stored maize throughout the year in relation to insect infestation has not been neglected. The following research on moisture contents of maize has been carried out:—

(a) the pick up of moisture by artificially dried grain during the wet season from December to March.

(b) the drying out of maize on the cob with sheath coverings present and absent, and stored under African village conditions during the cool season from April to June.

(c) the drying out of shelled maize in bulk and in bags during the hot dry season from September to November.

Tests are about to be undertaken to ascertain the susceptibility of different types of maize, grown in Nyasaland, to insect attack. For these tests *C. oryzae* L. and probably *S. cerealella* will be used.

NOTE.—The author is in the process of preparing a full and detailed report on all the investigations outlined above. This final report should be available by May of 1954 and is likely to be published as a Colonial Office Research Publication.

Summary

In review it may be pointed out that the cropping season of 1953 was a favourable one which was generally free of outbreaks of a serious nature. The local high insect populations, which sometimes appear, emphasize the need for the planter to be ready with his insecticides and spray equipment so as to deal with any chance occurrence of such pests.

Visits

During August and September two specialists from the East African Agricultural and Forestry Research Organization, Mr. Sands and Mr. Wilkinson, conducted a survey of the termites of Nyasaland. In October the Entomologist paid a brief visit to Mbosi, Tanganyika, to discuss with Mr. R. G. Tapley, Entomologist, means of controlling white stem borer in coffee.

REPORT OF THE AGRICULTURAL CHEMIST.

This report covers briefly the work of the Zomba laboratory, and in more detail the activities of the laboratory at the Tung Experimental Station.

At the Zomba laboratory, investigations into the correlation between soil analyses and phosphate response continued.—Birch of E.A.A.F.R.O. submitted a theory that base saturation was inversely related to phosphate response. Although excellently supported by experimental data gathered in Kenya, the theory, when applied to results of Nyasaland fertilizer trials, gave no significant results whatsoever. It was decided, therefore to attempt to correlate phosphate responses with a more complex relationship. Birch stated that pH was a good alternative measurement to base saturation for assessing phosphate responses. This is obviously so in some cases, but not all. The ratio of total exchangeable bases to hydrogen should also be considered, as an unconsidered factor may influence the pH. For example, some soils high in exchangeable sodium have an acid reaction.

Initially, phosphate response was plotted against the relationship $(\text{pH} \times \text{S/H})$. No correlation was evident. Suggestions in a recent American publication that conductivity was related to soil fertility led to determination of a large number of soil conductivities and significant relationship between conductivity and $(\text{pH} \times \text{S/H})$ was noticed. Conductivity multiplied by $(\text{pH} \times \text{S/H})$ and plotted mean response to phosphate fertilizer gave a curve which enables one to suggest that, with regard to maize and groundnuts, if the expression $(5 \times \text{EC}5 \times 103) \times (\text{pH} \times \text{S/H}) = Z$ is below 10, then response to phosphate fertilizer may be expected. This does not appear to apply to tobacco, indeed, depressed yields were apparent with a figure $Z=10$.

Some maize soils were off the curve and a plan for future research is indicated by the fact that soils which do not support this theory were those with very high calcium content, in some cases 100 per cent. saturation.

SUGAR CANE INVESTIGATIONS

Throughout the year examination of the effects of irrigation of the proposed sites at Alimenda was continued. This involved the analysis of 400 water samples drawn from leaching drain and from piezometer sites. In view of the fact that water of pH up to 9.5 was encountered—small scale pot experiments were made at Makanga to trace the effect of salinity and alkalinity on the growth of sugar cane.

SHILWA RICE SCHEME

The water from Lake Shilwa and from the rivers of the neighbourhood were analysed to assess their suitability for irrigating the area of the proposed Rice Scheme. Lake Shilwa water was found to be too saline, but the rivers that flow into the Lake would be quite suitable. Soils were also examined from this area and by means of drainage trenches the effects of irrigation were initially examined.

WATER DEVELOPMENT BRANCH

The Division continued to analyse the water collected by the Water Development Branch, for silt content. During this period some 1,800 samples were analysed. The determination of pH and conductivity of these waters was also introduced.

COMPOSITION OF TUNG OIL

These studies have continued occasionally but no definite conclusions have yet been reached, except that the clonal variations suggested in last year's Report do not seem to be borne out on examination of more seed. Oils of heat test of 25 mins. contained 72 per cent. Methyl α elaeostearate with 75-77 per cent. when the heat test figure was 23 mins.

FACTORY EXPELLING AND INVESTIGATIONS

Several samples of feed and cake taken at the Zomba factory showed it to be working quite efficiently and consistently—cake of 6-7 per cent. oil content being obtained. This would appear to be related to the more uniform and drier climatic conditions. But the newness of the plant and the possibility of better insulation on the kettles may be contributory factors—as no live steam is being used to heat the seed. Similarly, at the Cholo factory the use of a series of three kettles now obviates the need for live steam. The installation of a vibrating screen separator for foots, and a filter press by the management at Cholo, has increased the efficiency of the process.

The Drier installed at the Cholo factory has been found successful and samples of the drier seed and kernel has been examined in the laboratory. Analysis of the solvent extracted oil showed no deterioration, thus confirming the findings of the laboratory tests made in 1951. The oil mechanically expressed from the dried seed also had normal characteristics. The factory reported that it was noticed that less kernel was lost while decorticating wet seed, than when decorticating dry seed. As the loss of oil in chipped kernel is appreciable, the practicability of decorticating wet seed and then drying the kernels before expelling is being investigated.

Nutritional Problems

LEAF ANALYSIS

Several cases of dieback and poor growth of tung on estates were investigated, by soil and leaf analysis, following an examination of the soils of these areas. In some instances the soils were not suitable, containing gravel and concretes at 18ins. $\times$ 2ft., whereas in other instances the matter could be rectified by suitable use of fertilizers.

Leaves from a "dieback" area and an adjacent area, where tung cake had been applied, were examined. The former were yellow, and although the latter leaves were green, they were not as large as the average leaf at the Tung Stations.

Analyses of the air dry leaves gave the following results:—

(All figures are expressed in percentages)

					Moisture	N	P	K	Ca
Green leaves ..	..	..	..	..	9.0	1.8	0.12	0.85	2.7
Yellow leaves ..	..	..	..	..	8.5	1.1	0.09	1.04	4.1

These figures giving the composition by weight of the leaves must also be considered in terms of total nutrients per leaf. The yellow leaves weighed about half as much as the green leaves;—thus the total N and P in the leaves is only about one-third of that in the green leaves, whereas the K and Ca is about the same. While the Ca and K uptake is satisfactory, there is an appreciable deficiency of N and P.

On another estate, which could be divided into two sections, one of fairly satisfactory tung, and the other of inferior tung, soil analysis showed no particular reason why these should be different; but leaf analysis showed a marked difference in nitrogen content in leaves from the two sections. The good section has been cultivated and intercropped, whereas the inferior area is under grass which has been only occasionally cleared.

The results of the analysis are given below:—

					Per cent. on oven dry leaf				
					% Moisture	% N	% P	% K	% Ca
Satisfactory Tung ..	..	..	..	..	10	2.5	0.18	0.89	2.27
Inferior Tung ..	..	..	..	..	11	1.6	0.26	1.32	2.53

Taking into consideration the size of the leaves the N content per leaf of the poorer leaves is only about one-third that of the good leaves.

FERTILIZER VALUE OF TUNG CAKE AND ITS COMPONENTS

In order to ascertain more closely the fertilizer value of tung cake, the composition of its components were analysed so that any variation due to different expelling conditions might be defined. The oil itself, being carbohydrate, will only affect the N.P.K. content in so far as it may dilute the other components. The kernel residue is likely to be the most important part as its nutrients are more easily released than

are those from the harder shell. The availability of nutrients will therefore probably depend on the percentage of kernel residue in the cake. Representative figures for the components are as follows, but the figures will vary according to the nutrients available to the tree initially.

(All figures are expressed in percentage)

						Per cent. on dry material				
						Moisture	N	P	K	Ca.
Shell	..	..	..	..	..	12	0.6	0.04	0.4	0.6
Kernel Residue after removal of oil ..						6	6.2	1.2	1.2	1.05

The oil contained negligible amounts of N. P. and K.

Considering two conditions of shell and oil content in the tung cake, the following are the calculated amounts of nutrients which they would contain.

(All figures are expressed in percentage)

Shell Content	Oil Content	N	P	K
30	7	4.1	0.8	0.9
30	12	3.9	0.35	0.8
40	7	3.6	0.35	0.8
40	12	3.3	0.5	0.7

These figures are in agreement with those previously obtained by analysis of the cake itself.

RHODES GRASS

On Road Field (Field 12), at the Tung Station it was reported that there were a number of small areas of Rhodes grass which were appreciably better than the bulk of the field—the superiority being indicated by a better colour and vigorous growth.

This matter was investigated, during July, by analysis of grass, and soil from the good and bad areas, and also by examination of the underlying soils in a number of places.

An inspection of the field suggested that the good areas corresponded to the position of ant-hills. The digging of pits confirmed that ants were active in three such places, whereas smaller pits sunk in the adjoining poorer areas revealed no ants.

The results of the grass and soil analyses are shown below.

ANALYSIS OF RHODES GRASS

					Air dry grass	Composition of Oven dry material				
					% Moisture	% N	% K	% P	% Ca	
Good Area	..	..	..	..	12	1.16	1.57	0.25	0.46	
Poorer Area	..	..	..	..	13	0.63	0.48	0.33	0.48	

SOIL ANALYSIS

		PH	Base Capacity	H	Total Bases	N	Available Phosphate	Phosphate Reserves	K
			m.e. per	100 gm.		Per cent.	p.p.m.	P	m.e. per 100 gm.
Good area	..	6.3	10.6	2.5	8.5	0.10	40	102	0.90
Poorer area	..	6.2	10.0	1.9	7.1	0.85	44	134	0.68

The analysis of soils and grasses was carried out on a representative sample bulked from five areas.

The leaf analysis show that the nitrogen and potassium contents are higher in the good grass. The phosphate content is slightly higher in the poorer leaves, but this is usual, where the soils are supplying

adequate phosphate and there is a shortage of growth due to other factors. A consideration of nutrient on a per leaf basis, increases the difference between the good and bad grasses.

The low K status of both soils and grass in the poorer areas is noticeable and is being further investigated.

Although the existence of ant hills generally coincided with the good areas—there were some “ hills ” in the field on which the grass was poor. On digging, it was found that these hills were not ant hills but were caused by some external factor. For instance, one was found to consist of sub-soil piled on the original surface soil—where perhaps a house had been removed or where some other digging had been done.

It thus appears that the variation in growth of Rhodes pasture is due to the presence of ant-hills, which are known to contain more nutrients than the surrounding soils. No evidence was found for the suggestion that the good soils corresponded to positions where trees had been removed—in fact experience has shown that stumping brings to the surface the sub-soils which reduce the fertility.

How far the presence of ants has helped growth by aeration and assisting root penetration is not easy to assess—but experience in examining pits at various sites on the top ridge of the Tung Station has shown good penetration in these soils by roots of all kinds. Similarly, as there is no evidence of pan formation, the value of sub-soiling is rather doubtful.

Investigations on Tea Problems

Several nursery sites were examined where the plants were dying off. Generally the PH of these soils was higher than usual at 6.2–6.4, Laboratory tests on the effect of sulphur application on these soils showed a marked decrease of pH as shown by the following example:—

				<i>Ph values</i>			
<i>Soil A</i>				3/6/53	12/6/53	6/7/53	
Soil only	..	..	..	6.22	6.37	..	6.16
Sulphur application = 10 cwts./acre	..		..	—	5.84	..	5.22
= 20	..	..	..	—	5.68	..	4.71
= 40	..	..	..	—	5.72	..	4.27
= 80	..	..	..	—	5.90	..	4.00

From the graph for these figures it is clear that 5 cwts./acre would reduce the pH by about 0.5–0.7 after a month's oxidation.

Application of sulphur to the nurseries produced marked improvements in the tea. In some nurseries the trouble was encountered on sites which had previously grown satisfactory plants. It may be that at this pH, the Aluminium available in the soil would be sufficient for one season's plants, but not subsequently.

COTTON

(By H. C. DUCKER AND R. SMITH)

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In general, planting conditions were somewhat unsatisfactory, though certain parts of the Southern Province were favoured with good early rains. The Chitala area of the Central Province, wherein the station is situated, was particularly unfortunate and has suffered drought conditions comparable with those of 1948-49. In addition, for reasons at present imperfectly understood, the Chitala area suffered from a very heavy infestation of red bollworm, *Diparopsis castanea* Hmps., which resulted in excessive losses of buds, flowers and bolls. The station crops had to be planted very late in December owing to the non-arrival of suitable rains, and the combination of circumstances resulted in the second low yield of cotton per acre to date. The enforcement of close season measures in 1952 was most efficient and the conclusion must be reached that July 31st uprooting does not always operate as an effective control of the major Nyasaland cotton pest at the middle and higher elevations. Reports in support of this have been received from Gatooma, Southern Rhodesia. The success of the summer crop regime report for last year is, therefore, in doubt, and the position needs to be reviewed.

In the Lower River, on the other hand, the success of 1952 was repeated in 1953 with yields per unit area fully as high as those achieved last year, though damage by stainers, *Dysdercus* spp., was greater. These pests invaded the cotton crop earlier than is usual, and it is thought that seasonal fluctuations in the fruiting of their wild host plants may have been responsible. Reports of serious damage due to anthracnose, *Glomerella gossypii*, were not substantiated, the overwhelming proportion of the staining being due to *Nematospora* spp. transmitted by the stainers.

The Northern Province had a good year in 1952, but poor flooding due to the partial drought here resulted in a drop of acreage for 1953.

The results of the Egyptian type cotton trials in 1952 were disappointing, and though they have been repeated in 1953 it is not thought that these cottons can compete with Uplands as a winter crop in Nyasaland. The figures for Karonga (North Nyasa) and Nchalo (Lower River) trials are summarized in Table 1.

TABLE 1
YIELDS IN LB. SEED COTTON PER ACRE

	Karonga	Per cent. CLB	Nchalo	Per cent. CLB
BAR 4/16	242	13	339	24
XL1	252	14	358	26
BLR 14/25	338	18	360	26
Domains Sakel	190	10	378	27
X1730A	298	17	366	26
BP 52	850	47	—	—
CLB Local	1,800	100	1,386	100
Sig. Diff. (P=0.05)	158	9	136	10
S.E.	57.0		49.1	

The superior yielding power of the Uplands is sufficiently obvious, but the figures do not show the greater storm-proofness, a most marked characteristic. The Egyptians all shed seed cotton freely in any wind.

Rainfall at the Cotton Experiment Station was as follows:—

<i>Inches</i>									
1952			1953						
Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
0.08	3.24	2.41	8.21	6.64	3.87	—	—	—	—

The total of 24.45 ins. was nearly 10 ins. below the 20-year average, and the actual start to the planting season was about the latest on record. The mid-November rainfall was useless to crops since it was followed by a long and severe spell of hot dry weather not broken until 28th December.

A series of varietal trials to compare CLB, CL20 and leading East African varieties was laid down in co-operation with the Department of Agriculture, officers of which cared for all outside experiments. Results are shown in Table 2.

TABLE 2
YIELDS IN LB. SEED COTTON PER ACRE

	Chitala	Tuchila	Kakoma	Ngabu	Makanga	Misange	General Mean
CLB	385	530	851	645	1,240	857	751
CL20	542	675	1,022	829	1,218	734	837
Uk48	410	552	802	—	1,225	—	747
Uk51	367	515	910	690	1,240	—	744
S47	358	525	923	650	1,046	661	694
BP52	380	449	878	632	949	—	658
Sig. Diff. P=0.05	52	78	82	124	187	115	—
S.E.	18.8	28.2	29.6	44.8	65.1	41.5	—

Seed weights and consequently ginning outturns were very variable from site to site, owing to fluctuations in stainer damage. *Tuchila* was the worst affected with over 53 per cent. stained cotton, mainly by stainer-carried *Nematospora* spp.

Lint samples from the Chitala Cotton Experiment Station and Makanga Department of Agriculture trials, of all but the two Uganda varieties, have been sent to the Shirley Institute for large scale testing.

CL20 has proved to be at least as good a yielder as its parent CLB, while neither of the Tanganyikan cottons surpasses them. The Uganda cottons seem less well suited to Nyasaland summer crop conditions, and a definite decision has been made to discard S47. BP52 still offers possibilities as a parent stock in new crosses.

The simple fertilizer experiment comparing two levels of nitrogen was repeated, but showed no treatment effects this year. Dry conditions and poor yields owing to excessive bollworm were presumably responsible. In the first year, following the application of fertilizers to maize, however, a significant residual effect of phosphorus was recorded on the CL20 cotton bulk planted in the previous experimental area. The results are shown in Table 3.

TABLE 3
YIELDS IN LB. SEED COTTON PER ACRE (1953)

	N	P	K	
0	325	263	321	Sig. Diff. P=0.05 34 lb. S.E. 12.3
1	317	351	315	
2	332	360	338	

Applications (1952).

0 = Nil.

1 = 100 lb. Ammonium Sulphate (N) or 200 lb. of a commercial mixture of rock superphosphate (P) or 25 lb. KCl (K).

2 = Double amounts shown in 1.

BACTERIAL BLIGHT

The incidence of this disease was generally light on the station, only the angular leafspot and stem lesion phases being commonly observed. The plants showing most infection were on the heavier soil, and these grew away from the disease later as the rains ceased. Elsewhere in the country, though not in the Lower River, bacterial blight was reported to be doing damage, but no statistical evidence has been advanced.

Seed dusting with "Perenox" was the subject of experiment at the station and on outside plots run by the Department of Agriculture. Table 4 shows the results.

TABLE 4. YIELDS IN LB. SEED COTTON PER ACRE

	Chitala	Tuchila	Ngabu	Makanga	General Mean
CLB plain ..	305	435	641	1008	597
CLB Perenox.	346	430	515	754	509
Sig. Diff. P=.05	52	78	124	187	
S.E. ..	18.8	28.2	44.8	65.1	

The results were complicated by rather irregular stands in the Lower River experiments, but do not suggest any immediate advantage from the dusting treatment. The experiments will be repeated on a larger scale next season.

The Government Pathologist made isolations of *X.malvacearum* last year and cultures from these were tested in the field. None appeared to be pathogenic, as neither seed immersion in culture suspensions nor needle inoculation tests (Wickens) produced any symptoms of the disease.

Of the parent material for resistance, first grown this year, Stoneville 20 × Albar 49 suffered severely from jassid damage. The Albar 51 strains germinated very badly and suffered much from bollworm. The crosses, Albar 49 × CL20 and Albar 49 × BP52 × CL20 were grown in their third year of "panmixis". They were rogued for jassid susceptibility and, so far as was possible, for bacterial blight attack, infected plants being removed from the plot. "Rubbish" such as segregates showing no lint and other freaks were also eliminated and full fuzz bulks are being kept for further study.

RED BOLLWORM (*Diparopsis castanea* Hmps.)

As the early sown summer crop regime is well established in all cotton growing areas of the Central and Southern Provinces, an attempt was made to observe the development of the crop in relation to the surviving infestation of red bollworm. Bulk CLB was sampled at Chitala and Makanga.

The accumulation of bolls per plant per week and the accumulation of bolls damaged by red bollworm, also per plant per week, were counted for 200 plants (samples of 10) at Makanga and for 240 plants (samples of 10) at Chitala. The results showed the differences in red bollworm attack at the two sites and indicated the development of the heavy infestation at Chitala. At Makanga the crop had formed the majority of its bolls before red bollworm entered the fields to any extent early in April, the final figures for damaged bolls being only 14 per cent. At Chitala, red bollworm was consuming the developing flower buds as early as 14th February, causing heavy loss of forms and damage to the majority of the bolls remaining on the plants. This continued until the first week in April, when very few further bolls could be made owing to the abrupt cessation of the rains, and developing aridity. No more red bollworm damage occurred until the end of April, simply for lack of plant material. Harvesting was started on 13th May, plants being picked fortnightly till 13th June; of the bolls picked 70 per cent. were damaged by bollworm, 17 per cent. by stainer-carried disease and only 13 per cent. were clean and white. The final yield from the bulk fields of CLB at Chitala was only 101 lb. seed cotton per acre, while at Makanga it was nearly ten times as large.

It appears from this data that the date of entry and intensity of the red bollworm attack on cotton varies considerably with local conditions under the early sown regime. The problems are mainly if not entirely entomological.

This high bollworm damage recorded at Chitala may be due to the cumulative effects of:—

(a) High bollworm population, due to a heavy carry-over of pupae from 1952 in the station lands.

(b) A reduction owing to the drought in commercial cotton plantings in the immediate area of the station, so leading to immigrations by moths bred elsewhere.

(c) Red bollworm destruction of early flower buds, causing a reduction in the number of bolls formed during the critical fruiting period.

(d) Relatively dry conditions causing slow or lessened flower production, thus upsetting the pest/food ratio.

Heavy red bollworm infestation may also depend on differences in planting dates of gardens owing to localized planting rains. In early-planted fields flowering occurs earlier, especially where the crop is well-cultivated, than in the main sowings, and would attract a majority of emerging moths. To what extent each of the possible factors is responsible at Chitala this year, it is not possible to estimate. The infestation may be due to a number of the factors combining fortuitously.

At Makanga, with the different seasonal conditions of the Lower River, especially rather better rains, the crop did not lose its early forms and so produced a greater number of bolls more rapidly. Red bollworm infestation occurred only after the majority of the bolls were well advanced to maturity, and damage was slight. The portion of red bollworm damaged bolls to clean bolls was very slight, and reflected in a yield of approximately 1,000 lb. seed cotton per acre.